Future electronic communications product and service markets subject to ex-ante regulation

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Future electronic communications product and service markets subject to ex-ante regulation

Recommendation on relevant markets

FINAL REPORT

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Abstract

The European Electronic Communications Code requires the Commission to review the 2014 Recommendation on Relevant Markets by 21 December 2020. This study provides an analysis of technological and market developments, as well as relevant cases, to assist in determining whether changes may be needed to the current Recommendation.

Key supply-side developments include the migration from copper to fibre and the deployment of 5G. Meanwhile, increased trends towards home working and the digitisation of industry and public services, are likely to drive the need for more performant infrastructure.

Infrastructure competition in broadband networks and/or entry by new players focused on VHC broadband deployment has developed in some areas. However, competition in many areas is dependent on SMP regulation.

We conclude that it may be justified to maintain the existing market for “Wholesale Local Access”, and adapt the existing market for “High Quality Access” to focus on dedicated access including dark fibre for backhaul. These markets may be geographically differentiated based on a detailed analysis. The Wholesale Central Access market tends towards competition and could be removed from the list. Termination markets may also be removed from the list as Eurorate regulation should address the primary competition concerns in this market.

Résumé

Le Code Européen des Communications Electroniques impose à la Commission de réexaminer la Recommandation sur les Marchés Pertinents de 2014 au 21 décembre 2020. Cette étude fournit une analyse des évolutions technologiques et du marché, ainsi que des cas pertinents, afin d'aider à déterminer si des modifications doivent être apportées à la Recommandation actuelle.

Les principales évolutions du côté de l'offre comprennent la migration du cuivre vers la fibre optique et le déploiement de la 5G. Dans le même temps, la tendance croissante au travail à domicile et la numérisation de l'industrie et des services publics sont susceptibles de demander une infrastructure plus performante pour assurer ces services.

La concurrence entre infrastructures dans les réseaux haut-débits et/ou l'entrée de nouveaux acteurs dans le déploiement du très haut débit (THD) se sont développées dans certaines régions. Toutefois, dans de nombreux domaines, la concurrence dépend de la réglementation sur la puissance significative sur le marché.

Notre conclusion est que le marché de l'"accès local de gros" peut être maintenu et le marché existant de l'"accès de haute qualité" devrait être adapter pour se centrer sur l'accès spécifique, notamment la fibre noire pour le backhaul. Ces marchés peuvent être différenciés géographiquement sur la base d'une analyse détaillée. Le marché de l'accès central de gros

tend vers la concurrence et pourrait être retiré de la liste. Les marchés de terminaison d'appel peuvent également être retirés de la liste, car la réglementation de l'Eurorate doit répondre aux principaux problèmes de concurrence sur ce marché.

Kurzfassung

Der Europäische Kodex für elektronische Kommunikation (EKEK) verpflichtet die Kommission, die Empfehlung über relevante Märkte von 2014 bis zum 21. Dezember 2020 zu überprüfen. In dieser Studie wird eine Analyse der Technologie- und Marktentwicklungen sowie relevanter Fallbeispiele durchgeführt, um festzustellen, ob Änderungen an der aktuellen Märkteempfehlung erforderlich sind.

Zu den wichtigsten Entwicklungen auf der Angebotsseite gehören die Migration von Kupfer auf Glasfaser und der Ausbau von 5G. Der verstärkte Trend zur Telearbeit und die Digitalisierung von Industrie und öffentlichen Dienstleistungen treiben den Bedarf an einer leistungsfähigeren Infrastruktur voran.

Der Infrastrukturwettbewerb auf Breitbandnetzen und/oder der Eintritt neuer Marktakteure, die sich auf den Ausbau von VHC-Netzen konzentrieren, finden in einigen Gebieten statt. Allerdings hängt der Wettbewerb in vielen Bereichen von der Regulierung auf der Grundlage von beträchtlicher Marktmacht ab.

Wir kommen zu dem Schluss, dass es gerechtfertigt sein könnte, den bestehenden Markt für auf der Vorleistungsebene an festen Standorten lokal bereitgestellten Zugang zu Teilnehmeranschlüssen beizubehalten und den bestehenden Markt für auf der Vorleistungsebene an festen Standorten bereitgestellten Zugang zu Teilnehmeranschlüssen von hoher Qualität so anzupassen, dass er sich auf den dedizierten Zugang einschließlich Dark Fibre für Backhaul konzentriert. Diese Märkte könnten auf der Grundlage einer detaillierten Analyse geografisch differenziert werden. Der Markt für den zentralen Breitbandzugang für den Massenmarkt tendiert zum Wettbewerb und könnte möglicherweise von der Liste gestrichen werden. Auch die Terminierungsmärkte können von der Liste gestrichen werden, da die Eurorate-Regulierung die primären Wettbewerbsbedenken in diesem Markt ausräumen sollte.

0 Executive summary

0.1 Introduction

The 2014 EC Recommendation on Relevant Markets[1] provides guidance to National Regulatory Authorities (NRAs) in identifying electronic communications markets within their jurisdiction which are susceptible to ex ante regulation. The current Recommendation includes four markets:

- Market 1: Wholesale call termination on individual public telephone networks provided at a fixed location
- Market 2: Wholesale voice call termination on individual mobile networks
- Market 3: (a) Wholesale Local Access provided at a fixed location (WLA); and (b) Wholesale central access provided at a fixed location for mass-market products (WCA)
- Market 4: Wholesale high quality access provided at a fixed location (HQA)

National Regulatory Authorities (NRAs) are required under the terms of the European Electronic Communications Code (hereafter EECC or Code) to take utmost regard of this Recommendation when defining markets in their jurisdiction.

The Code requires the Commission to review the 2014 Recommendation on Relevant Markets by 21 December 2020.[2] This study provides a quantitative and qualitative analysis of EU electronic communications markets, to assist in determining whether changes may be needed to the current Recommendation.

0.2 Technological and market developments

Since the last Recommendation on Relevant Markets was adopted in 2014, significant new technologies and services have entered the mainstream and new players have entered the market, while others have adapted their business models. This period has also seen new models of co-operation and a shift in some cases towards commercially negotiated wholesale agreements as an alternative to regulated access. These developments have led to changes in competitive dynamics and in the structure of some electronic communications markets.

Key developments within the coming decade are expected to include:

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1 Commission Recommendation on relevant product and service markets within the electronic communication sector susceptible to ex ante regulation in accordance with Directive 2002/21/EC https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014H0710&from=EN

2 Art. 64(1).

- Increased (upload as well as download) bandwidth needs for consumers to support future applications, including those in the fields of entertainment,[3] home working, eHealth and eLearning;

- Increased bandwidth, symmetry and quality requirements for connectivity to businesses, public institutions, schools and hospitals to support digital applications, cloud computing and the processing of big data. With the focus shifting to applications and software, large businesses may also increasingly purchase connectivity as part of a bundle of “IT” services;

- The move towards all-IP[4] and switch-off of the PSTN[5] network;

- The migration from copper to Very High Capacity (VHC) fibre[6] and cable networks. Switch-off of copper networks is expected to be completed in many countries within the next decade. During this period, there is likely to be an increased focus on supporting Gigabit connectivity via fibre and/or wireless solutions in rural areas;

- The launch of 5G mobile and fixed wireless services, alongside Internet-of-Things/Machine-to-Machine (IOT/M2M) applications in various fields, which are expected to develop in the coming years. Increased bandwidth demand and new applications will also drive the need for increased fibre connectivity to base stations and densification of the network;

- Specialisation by some operators in infrastructure (including wholesale only models) as a response to economies of scale in the access segment and the increased diversity and competition in the service segment. Other network operators may however seek to maintain a presence or enter downstream service markets (for content, cloud applications, IOT) as part of a vertically integrated strategy;

- In areas or Member States where horizontal splits between infrastructure and services do not occur, we can expect increased trends for convergence between fixed and mobile networks (driven by the investment requirements associated with 5G), and increased pressure for network sharing and/or access to dark fibre, in areas where the limits of viable duplication are reached.

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3 Key drivers of bandwidth demand for entertainment in the coming decade are likely to include the shift away from linear broadband TV to IP-TV and video streaming, the use of AR and VR in the context of gaming and the proliferation of devices.
4 Internet Protocol
5 Public Switched Telephone Network
6 Although there is an upgrade path for both copper (G.fast and successor solutions) and cable (to DOCSIS 4.0), these require increased deployment of fibre towards the end-user.

0.3 Regulatory developments

Regulatory developments may also affect how NRAs analyse markets and apply ex ante regulation in the years to come. Key changes associated with the new Code which are relevant to the market analysis process include:

- A new objective to promote connectivity to and take-up of very high capacity networks;
- An extension of the market review period from 3 to 5 years, requiring a longer-term perspective;
- A priority for NRAs to consider the sufficiency of duct and pole access before other remedies are applied;
- Requirements to collect data on the location of infrastructure (mapping), which could provide a valuable tool in conducting geographic market analyses;
- An increased focus on co-investment and wholesale only models as potential solutions in areas where infrastructure cannot be viably duplicated.

The Broadband Cost Reduction Directive (BB CRD) also provides an alternative route, aside from Significant Market Power (SMP) regulation, through which physical infrastructure access can be required, while Article 75 of the Code provides an EU-wide solution for the regulation of termination rates. Article 61 of the Code provides for the option of symmetric regulation of access networks in some circumstances. The interaction between these provisions and SMP regulation therefore also needs to be explored.

0.4 Retail broadband markets

0.4.1 Scope of the markets

The 2014 Recommendation distinguishes between the retail mass-market and retail high quality market for broadband. All fixed technologies are presumed to be included within these markets, ranging from copper-based technologies through to fibre to the home or premise (FTTH).

As FTTH becomes more widespread, businesses or sites with less demanding requirements are increasingly making use of “mass-market” broadband. However, an analysis of take-up trends and future demand in light of applications such as big data processing, eHealth and remote learning suggests that there may still be a distinct market segment for the highest quality of connectivity (dedicated connectivity), which is separate from the market for “mass-market” connectivity. Besides the presence of business-grade service levels, a key distinction between these segments is that high specification business products offer symmetric guaranteed capacity with very high quality of service specifications, and may to this end use a different architecture from FTTH which has been deployed for residential purposes.[7]

As customers migrate towards VHC broadband, reliance on copper is starting to decline. NRAs in Member States such as Sweden have observed that copper no longer provides a competitive constraint to higher bandwidth technologies. Copper-based traditional interface leased lines are also in decline in many Member States. Where copper is in decline or is in the process of being phased out, NRAs should consider whether copper should still be included in the same market as VHC broadband, or fibre-based leased lines. However, there are many Member States in which copper technologies still predominate, and where segmentation between copper-based broadband and higher bandwidth technologies may be premature.

An important development during the period of this Recommendation is the deployment of 5G. However, 5G mobile services are not expected to substitute for fixed broadband, due to the prevalence of data caps[8] within mobile pricing models and the shared nature of the medium, which limits its potential to carry the high data load currently supported by the fixed network. Moreover, 5G will likely require the deployment of fibre further into the network to provide high capacity backhaul to existing base stations, and in time, new small cells. The increasing reliance of mobile technologies on fixed backhaul provides a signal that VHC fixed networks and 5G technologies are likely to be complementary. 5G fixed wireless access (FWA) offers more promise as a potential alternative to wireline VHC broadband connections. However, its capabilities lie at the lower end of those available via FTTH. NRAs should thus consider whether it offers a substitute on a case by case basis, noting that it may offer a permanent alternative to copper infrastructure in very rural areas, while substitution between FWA and wireline VHC technologies in other areas may depend on the presence of and prospects for FTTH. 5G FWA is likely to be able to serve the needs of less demanding business users and use-cases, but is unlikely to provide an alternative to dedicated connections that are likely to be required for high-end business use, public institutions, educational facilities and hospitals.

0.4.2 Tendency towards competition

Consumers and businesses in most Member States have a choice of broadband provider. However, in the majority of cases this choice has been supported by the presence of SMP regulation.

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7 These distinctions may not apply where point to point fibre has been widely deployed to the mass market.

8 Many mobile subscriptions include a limited amount of data within the fixed monthly subscription price. Any data use above that limit is charged on a capacity basis.

If SMP regulation were removed, it is likely that the degree of competition would be much more limited, due to the high sunk costs involved in deploying telecoms infrastructure, which affects the degree to which this infrastructure can be viably duplicated. In particular, beyond cable, there are only a few countries in which competitors have duplicated the network of the incumbent without support from Physical Infrastructure Access (PIA) mandated via the SMP regime, and the coverage of these competitors is typically limited to more densely populated areas, or specific regions where these players may face limited competition, and therefore themselves benefit from a strong market position at a regional level. Some Member States have had success in making use of utility infrastructure for the deployment of VHC broadband, either through regulation applied in the context of the Broadband Cost Reduction Directive or through national measures which predated this Directive. However, access to utility infrastructure has been most frequently used in rural areas (poles), and its use is limited compared with the use of SMP PIA, and focused around specific countries. 5G FWA might increase the prospects for competition, but it is likely to act as a substitute only in specific cases (e.g. in rural areas or where FTTH has not yet been deployed), and its deployment may depend on access to ducts and poles and/or backhaul, which may require regulation through the SMP regime.

Competition in VHC broadband services could potentially emerge as a result of co-investment. However, evidence from those markets in which co-investment has developed suggests that its scope is typically limited to certain areas, and SMP regulation may be required to give alternative operators sufficient scale and leverage to reach commercial agreements for co-investment in VHC networks.

There is evidence that, in the absence of any ex ante regulatory remedies, the provision of dedicated access can be competitively supplied in some cases. However, this supply tends to be concentrated around densely populated areas and business districts, with limited infrastructure competition beyond these areas. As many larger businesses require simultaneous provision to multiple sites, and potentially several countries, the absence of competitive supply in one area could impact the ability of a business service provider to provide a competitive offer across all the locations required by the potential customer. There may also be a challenge in ensuring the competitive supply of dedicated connectivity for public institutions, health and education facilities as well as rural businesses which lie outside densely populated areas, which could exacerbate the urban rural digital divide.

0.4.3 Conclusion

There are separate markets for mass-market data connectivity (which may be used by consumers and businesses/sites with less demanding requirements) and dedicated access at the highest quality levels for business use. This distinction may not however apply where point-to-point fibre infrastructure (which can be used for both business and residential purposes) has been widely deployed.

These markets are unlikely to tend towards effective competition on a nationwide basis in the absence of ex ante regulation. However, there may be some areas which are competitively served on the basis of operators‘ own infrastructure, especially in business districts (for the provision of dedicated access), or in a few Member States and locations where entrants have deployed their own networks including ducts alongside those of the incumbent and cable operators.

0.5 Wholesale broadband markets

The current Recommendation on relevant markets includes three wholesale markets which are considered potentially susceptible to ex ante regulation: wholesale local access WLA (including physical and virtual unbundled local access), wholesale central access WCA (including bitstream access provided at a central or regional location) and high quality access HQA (including wholesale leased lines, and potentially business-grade bitstream). In our study, we consider the continued relevance of these markets for ex ante regulation, alongside the case for adding, removing or adapting wholesale markets. Significant focus is also given to circumstances in which geographic segmentation of markets may be appropriate.

0.5.1 Physical infrastructure access

The most upstream wholesale product which could support the deployment of broadband infrastructure is physical infrastructure access (duct and pole access). Most NRAs have mandated PIA as a remedy under the WLA market, and this approach is supported by Article 72 of the Code. However, some have concluded that PIA could substitute for physical or unbundled access (and therefore be included within the WLA market definition), and more recently the UK NRA Ofcom has decided and the French NRA ARCEP has proposed to identify telecom PIA as a separate market which is upstream from the WLA, WCA and HQA markets.

The use of PIA based on regulated access to the incumbent’s infrastructure is significant and expanding in some Member States. In cases where it has been used extensively, it has contributed to the development of infrastructure-based competition in dense urban areas and the deployment of networks in rural areas with the support of State aid. However, the success of PIA in these cases has in turn revealed a weakness in the strategy of imposing PIA on SMP providers as a remedy, as the development of infrastructure competition could result in different competitive conditions or different SMP providers in the provision of broadband services in different areas (potentially prompting geographic segmentation of the market), which may not be consistent with the need to maintain a nationwide SMP access obligation for PIA. Thus, the definition of a separate market for telecom PIA may be appropriate in Member States where SMP PIA is the primary mechanism which supports infrastructure-based competition in broadband services.

However, telecoms PIA mandated via the SMP regime may be less effective in facilitating broadband competition or not relevant in several EU member states. This may be the case, for example, where the incumbent PIA network is not fully ducted or is not ubiquitous[9] or where there is limited demand for PIA because unbundled fibre is widely available and meets most access seekers' needs. In these cases, mandating SMP PIA as a remedy in a downstream market, or through inclusion in the market definition for WLA is likely to be more cost-effective and appropriate than identifying a separate product market for PIA. This approach could also be used for a transitional period in countries where SMP PIA is expected to be an effective remedy in promoting infrastructure competition, but its effect is not yet clear in the market. The BB CRD provides a useful complement to SMP PIA, especially where access to utility PIA is relevant. However, the BB CRD is likely to be less effective than SMP PIA remedies in ensuring effective access to telecom ducts due to its reliance on dispute resolution, which implies a case-by-case approach, and the more limited range of remedies. SMP PIA should therefore be privileged for telecom duct and pole access regulation, in cases where telecom PIA is available on a widespread basis, and is in demand by access seekers.

In those countries where a separate product market for PIA is defined, it should in principle meet the three criteria test, due to the high costs of deploying ducts and limited prospects of effective competition in this area.

However, as a separate PIA market is likely to be relevant for only a few Member States today, it may not yet be appropriate to include this market in the list of markets in the Recommendation that are considered to be susceptible to ex ante regulation across the EU.

0.5.2 Wholesale broadband access

In the current Recommendation, the market for WLA is distinguished from WCA by virtue of the location of the access point (local vs regional) and the flexibility afforded to access seekers. Most NRAs across the EU have confirmed this distinction, although some such as ARCEP have distinguished between physical and active access, while others including NRAs in the Netherlands and Denmark have suggested that there may be a single market for wholesale fixed access on the basis of substitution across the range of wholesale offers available at local and regional level.

9 In these cases, access seekers may need to rely on a range of solutions to build networks, including self-deployment and use of utility PIA amongst other options.

Our analysis of the technological capabilities of wholesale access products and the business case for access seekers suggests that it remains appropriate to maintain a distinction between WLA and WCA. The local access point in a VHC context may in some cases differ from that which was traditionally provided for copper local loop unbundling, due to differences in the architecture of the network,[10] but should aggregate a sufficient number of connections to be viable for access seekers of efficient scale.[11] Although it is technically possible to provide Virtual Unbundled Local Access (VULA)[12] at a regional handover point, this would entail an absence of overbooking[13] in the core network, which would significantly raise costs (making the product more akin to a leased line). We also observe that when alternative operators climb the ladder of investment from WCA to WLA, this is likely to entail long term investments in backhaul and equipment. Operators which have made these investments are unlikely to have incentives to switch from a WLA to a WCA product, while those utilising WCA may not have the necessary economies of scale to make investing in WLA viable.

Within these markets, there may be a justification to segment copper (including potentially FTTC/VDSL[14]) from VHC technologies in cases where copper-based services no longer provide a pricing constraint on technologies which enable the provision of higher bandwidths or where switch-off is planned.

Wholesale products made available via DOCSIS 3.1 are not capable of meeting the functionalities associated with VULA, and therefore would normally not be considered to be included in the WLA market, although they may provide an indirect constraint.[15] DOCSIS 3.1 would however normally be included within a market for WCA.

The potential inclusion of FWA in the WLA and/or WCA markets on the basis of direct or indirect constraints should be considered on a case by case basis, as discussed in relation to the retail market.

The WLA market is likely to meet the 3 criteria test on an EU-wide basis due to significant scale economies associated with the deployment of VHC networks. 5G FWA may offer the potential for additional competition, but its effect may be limited to rural areas (or Member States where FTTH is not widespread). SMP PIA (where relevant

10 For example handover may be available at a subset of former MDF locations

11 Connection points which aggregate significantly fewer end-users than are available at MDF locations, are unlikely to be viable

12 Technologies such as SDN/NFV may provide more flexibility for access seekers to control the characteristics of the service, but this flexibility may not be made available in the absence of an access obligation, and access would still need to be provided at a local level to enable the VULA characteristics to be respected.

13 Overbooking refers to the practice within a shared network of reserving less bandwidth than that which could theoretically be used if all end-users utilised the maximum capabilities of their access connection. A connection which does not involve any overbooking is referred to as “dedicated” or “guaranteed”

14 Fibre-to-the-Cabinet with Very high speed Digital Subscriber Line

15 DOCSIS 4.0 may be capable of meeting these criteria, but is not expected to be widely deployed during the period of this Recommendation and mandated in an upstream market) or infrastructure competition from operators using their own duct and pole networks, could support infrastructure competition in some parts of the WLA market, but experience suggests that the scope of such competition[16] may be limited to between 10-30% of households, and market power may persist elsewhere (for the incumbent and/or other operators) due to limitations in the viability of duplicating VHC infrastructure. Symmetric regulation under Article 61 of the Code is unlikely to provide an efficient alternative to SMP access regulation, as its primary purpose is to mandate the sharing of in-building wiring or physical access up to the first concentration point, the provision of access may rely on dispute resolution, and the imposition of access obligations (including active access) beyond the first concentration point is likely to be justified only in exceptional cases and may be disproportionate when applied to non-SMP operators.

The WCA market may no longer meet the 3 criteria test on an EU-wide basis. NRAs in a number of Member States have found that this market is either wholly or partially competitive. This trend towards competition may continue as service providers climb the ladder of investment from WCA to WLA and/or purchase commercial WCA services which may be provided on a competitive basis. Reliance on WCA in more rural areas and for copper infrastructure may be more prevalent, reflecting the challenges in duplicating infrastructure in these cases. However, the availability of backhaul (including via the market for dedicated access where appropriate) may facilitate a further progression towards the use of WLA in rural areas and/or facilitate the deployment of FWA, which may provide a longer-term replacement for copper in very rural zones. In Member States where the broadband market would not be effectively competitive on the basis of WLA alone, there may be a case for NRAs to define and assess the 3 criteria test for WCA, or to define a single market, in specific cases where wide scale switching between local access offers and bitstream (including cable bitstream) could be expected.

0.5.3 Dedicated access

The current Recommendation includes a market for „high quality access“, which includes wholesale leased lines alongside business-grade bitstream. Most NRAs have continued to find that there is SMP in this market, but it has been fully deregulated in 7 Member States,[17] and subject to segmentation and partial deregulation on the basis of speed, interface and/or technology in several others.

Drawing on our analysis of the technological developments and supply conditions, we conclude that business-grade bitstream may have similar characteristics to, and could

16 Effective competition based on end-to-end infrastructure duplication, but potentially making use of SMP PIA

17 I.e. BG, DK, EE, LT, RO, SK, SE. See market overview table https://ec.europa.eu/digital-single-market/sites/digital-agenda/files/newsroom/art_7_march2020_57033.jpg

be provided by the same suppliers as are present in the market for mass-market WLA (although businesses may require higher level service agreements). Thus, NRAs could consider the competitive conditions for business-grade bitstream in the context of the WLA market analysis, and apply additional requirements regarding service levels in that context, where appropriate.

On the other hand, increased reliance on digital applications and big data processing by commercial and public sector organisations and „socio-economic drivers", alongside the upcoming deployment of 5G mobile networks, may increase demand for high grade wholesale dedicated capacity both to connect businesses and organisations and to extend fibre backhaul to increase capacity and improve quality on mobile networks. Some of these applications would benefit from dark fibre connectivity, due to the flexibility and scalability it offers, and operators offering leased line services would readily be able to switch supply to dark fibre and vice versa. Thus, we conclude that there is a wholesale market for dedicated capacity for a variety of use cases (including access and backhaul), which is likely to include both terminating segments of leased lines and dark fibre in the terminating segment.[18]

Copper-based traditional leased lines are in the process of being phased out in several Member States. When these lines no longer constrain the prices charged for higher bandwidth leased lines supplied over fibre, separate market segments should be identified, with a focus on higher bandwidth lines for the purposes of potential ex ante regulation, while the focus on legacy lines should be to manage the phase-out of these lines and the migration of end-users to modern interfaces.

The market for wholesale dedicated capacity (with a focus on higher bandwidth connections) is likely to meet the 3 criteria test, as there are areas in most Member States where it is not viable to duplicate dedicated capacity in the terminating segment, or in some cases to deploy it in the absence of state aid. Dedicated capacity is likely to be competitively supplied in some areas, including business districts. There may also be an enhanced business case for the deployment of dedicated capacity for shared use (for backhaul or multi-tenant buildings) compared with fibre for single premises, which improves the potential for competitive supply for these circuits. The business case for backhaul could be further improved through the use of PIA (where available) and network sharing. However, modelling and interviews on the usage of fibre backhaul by mobile operators suggest that there still remain areas where backhaul cannot be viably duplicated, and the owner of fibre backhaul connections in such areas may not have an

18 The terminating segment should be defined based on national circumstances, with a focus on identifying elements of the network for which replicability is likely to be most challenging (outside dense areas). Such elements could for example be defined through exclusion of trunk routes or with reference to architecture e.g. the link connecting the end-user site to the fibre serving exchange, but it should be verified in each case that the demarcation enables a distinction between links which cannot be readily duplicated in less dense areas and links which for the most part have sufficient alternative supply and/or aggregate sufficiently high levels of traffic that they could be competitively served.

incentive to provide access to or share their assets in cases where this infrastructure confers an advantage for its own fixed and/or mobile retail business. Owners of infrastructure in non-competitive zones may also be able to leverage this infrastructure to secure contracts for the provision of services to multi-site businesses.

Deployment of, or co-investment in FTTH/B by Mobile Network Operators (MNOs) may improve their potential reach and capabilities to deploy dedicated fibre connections including for backhaul, but, as discussed in relation to the WLA market, this reach is rarely nationwide and depends on national conditions (such as the availability of PIA). With the potential deployment of local/campus networks, there may also be players other than MNOs seeking access to dark fibre connections. Where there is a demand for very high quality, high bandwidth capacity (with the potential for expansion), there is limited prospect that technologies other than fibre could meet this need.

0.5.4 Role of geographic segmentation

Geographic segmentation has played a significant role in the context of the current WCA market and in the segmentation of NGA remedies in the WLA market. Some Member States have also segmented the HQA market. As competition in VHC develops, whether via SMP PIA or other means, we can expect an even more important role for geographic market segmentation in the WLA and HQA markets going forward, especially as copper is retired and competition conditions for VHC and dedicated fibre business access and backhaul become the primary focus of the market analysis.

NRAs will need to determine in each case the relevant geographic unit and criteria for „prospective competition“, and should preferably do so in a manner that is consistent across the EU. Based on an analysis of current practices, competitive developments in different areas and Member States and interviews with stakeholders, the following principles could support this analysis.

- NRAs should first assess whether there are any variations in competition at the retail level, following the modified greenfield approach (i.e. in the absence of VHC or dedicated access regulation). Variations could take the form of different main suppliers, different numbers of infrastructure-based suppliers, differences in retail competition (e.g. number or nature of ISPs), quality and prices available, or stark differences in wholesale market shares (including self-supply). The drivers of different consumer outcomes such as choice, price and quality should be noted as these may be relevant for the wholesale criteria and analysis. If competitive differences are found at the retail level, a detailed geographic analysis should be conducted at the wholesale level;

- A wholesale analysis based on actual data and prospective deployment will be relevant in Member States where VHC deployment is advanced. A theoretical analysis based on the business case for and likelihood of deployment may be appropriate in Member States where VHC is less advanced;

- The geographic units chosen should, as far as possible, enable a reflection of the scope of coverage of existing infrastructure-based competitors e.g. cable or municipal and the relevant areas for investment decision-making for potential new entrants. Areas should be aggregated into zones which may not necessarily be contiguous, but which exhibit similar SMP conditions (e.g. prospective competition vs joint or single SMP, identity of the SMP provider). Where FTTH is not widely deployed, the considerations for assessing geographic differences in relation to dedicated access may differ from those for the mass-market.[19] However, the indicators for geographic segmentation for mass-market and dedicated access may converge when FTTH has been widely deployed;

- Numbers of networks are relevant, but not definitive, as NRAs should primarily be guided by distinctions in market conditions which result in different conclusions in different areas regarding SMP. When assessing the degree of infrastructure competition present in a given area, networks should only be taken into account if they are independently operated. This is likely within a co-investment in the presence of physical access and Indefeasible Rights of Use (IRU). The fact that a network is wholesale only does not necessarily imply that the presence of two networks is sufficient[20] – the impact of the business model of such players would need to be assessed at the retail level. Coverage requirements per operator should take into account the potential for expansion[21]. Higher coverage and overlap requirements would likely be needed where there is a limited prospect of network expansion;

- Market shares should be considered as an indicator of the potential business case for a wholesale only investor or for an existing operator to (co-)invest. 40-50% shares for the incumbent may be a relevant threshold indicating increased competition levels (alongside other factors such as the number of operators); and

- The prospect of wholesaling on fair and reasonable terms for the mass-market and high-end business supply in the absence of regulation should be taken into account, in order to assess whether entry barriers will remain limited in the absence of regulation.

0.6 Fixed and mobile telephony

NRAs today regulate fixed and mobile termination through the market analysis process. Although SMP regulation is applied to termination, all operators are typically found to

19 Prior to the widespread deployment of FTTH, it may be relevant in the case of dedicated access to consider distance of end-user sites from the networks of the potential suppliers to gauge the possibility for those suppliers to extend their networks to serve those sites.

20 Wholesale only may encompass a variety of business models from dark fibre only through to resale, and wholesale terms and the associated impacts may vary.

21 The potential for expansion may be greater during the early deployment phase where PIA is available and effective have SMP due to the fact that there is one way to reach those customers (through the number assigned to them), and customers are not aware of, or, in the case of mobile communications, influenced by the termination rate when they buy a package of services.[22] A key remedy applied by all EU NRAs under SMP regulation has been price caps on the fixed and mobile termination rates, based on the 2009 Recommendation on the Regulatory Treatment of Fixed and Mobile Termination Rates in the EU.

There is no evidence that in the medium term, alternatives to managed voice such as OTT are likely to apply a significantly greater constraint on the pricing of services offered by fixed and mobile operators and service providers than exists today, and this presumption tends to be confirmed by data on the usage of telephony.[23] However, the inclusion of markets in the lists of markets susceptible of ex ante regulation, is only justified for markets passing the three-criteria test under a ‚modified greenfield' approach, i.e. taking into account all applicable regulatory obligations (except the SMP regulation in the market reviewed). Under the EU electronic communications Code, an EU-wide price cap will apply to termination rates according to Art. 75 irrespective of any potential SMP finding. Because competition restrictions on the termination markets mainly result from the fact that network operators can set termination rates without being constrained by other market players or subscribers, due to action at EU level which address these concerns, it can no longer be argued that the structure of the termination markets will not tend towards effective competition. This suggests that the inclusion of the termination markets in the list of markets susceptible to ex ante regulation is no longer warranted.

Many network operators and some NRAs agree that as price has been the primary concern associated with termination, there would no longer be a need to review termination markets under the SMP regime. However, other NRAs and smaller service providers, have highlighted that non-price issues may remain, including a risk that larger firms could discriminate against smaller service providers and MVNOs and/or create challenges in the interconnection process for current voice services – and future generations of services such as Rich Communications Services (RCS).

It is indeed possible that some challenges may continue to be present in newly to be defined interconnection markets in certain Member States. However, we note that there are mechanisms available within the Code that could enable NRAs to address such challenges. Specifically, article 61 of the Code coupled with article 26 permits NRAs to impose obligations on interconnection and to resolve associated disputes.

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22 These challenges stem from the calling party pays system. Different dynamics and incentives exist in countries using the receiving party pays system.

23 This is confirmed by the continued reliance by end-uers on managed telephony to reach contacts outside their work and social network (made possible due to the any-to-any connectivity offered through managed voice). It should also be noted that telephony volumes have increased significantly alongside volumes of OTT applications during the distancing measures imposed as a result of the Coronavirus, and that not all users of telephony are able to access OTT applications.

In order to ensure a consistent and appropriate use of provisions on interconnection under the Code, guidance could usefully be provided on this issue by BEREC and/or the European Commission.

0.7 Summary of relevant markets for potential inclusion in the Recommendation

Drawing together our analysis of the impact of the potential options for each of the markets that could be included within the list of relevant markets, we conclude that:

- In Member States where SMP PIA is the primarily means by which infrastructure competition and/or new entry has developed or can be expected to develop, there is a case to define a separate market for PIA. In Member States where SMP PIA is not expected to be the primary means to support infrastructure competition or entry, it may be more appropriate to rely on PIA as a remedy or as a potential substitute for local access in the context of the WLA market. This solution may also be cost-effective for a transitional period in Member States in which SMP PIA is expected to become the primary means to support infrastructure competition, but where it has not yet been widely utilised. A separate PIA market is likely to be relevant for only a few countries today, so it may not yet be appropriate to include this market in the list of markets in the Recommendation that are considered to be susceptible to ex ante regulation across the EU;

- There is a case to maintain the market for WLA (and remove the market for WCA), as this could strengthen the focus on implementing VULA or physical unbundling at an economically viable connection point and in a manner which offers the maximum degree of flexibility for the access seeker. Competition in VHC broadband in more remote areas could be supported through regulation of the appropriate backhaul connections (where necessary), enabling the use of local access solutions, alongside support for the development of wireless access solutions in these locations;

- There is a case to maintain, but to adapt the currently defined market for high quality access (terminating segments only) so that it: (a) focuses on dedicated/guaranteed bandwidth for any purpose; (b) includes dark fibre access; and (c) is subject to a geographic analysis and potential segmentation;

- There is a case to remove the current markets for fixed and mobile termination.

0.8 Impact of these changes

The impact of these proposed approaches compared with potential alternative options is further explored in chapter 7 of the report. In particular, we anticipate that, in those Member States where SMP PIA is the primary mechanism supporting VHC deployment by alternative operators, the definition of a separate relevant product market could ensure the long-term sustainability of this measure, fostering infrastructure competition in dense urban areas and competition for VHC supply in zones which cannot be viably duplicated (including areas supported by State aid). Our models suggest that in those Member States and areas where PIA is relevant and effective, it could reduce costs for deployment by alternative operators by between 10-25%. In turn, in such Member States, this could facilitate downstream deregulation in some areas, providing more flexibility for service and price innovation. At the same time, where SMP PIA is not the primary mechanism for infrastructure competition, continued reliance on PIA as a remedy or substitute for WLA will ensure that some benefit can be gained from this measure, while limiting the administrative burden.

The maintenance of a market for WLA alongside the removal of the WCA market could serve to increase the focus on mandating physical unbundling and/or wholesale products which meet the specifications required for VULA, including wholesale products which make use of SDN/NFV[24] and, potentially, wavelength unbundling. In turn, customers should benefit from increased competition in quality and price, as competitors vie to make the most of the flexibility afforded to them (which will always be maximised in the case of physical access).[25] Removal of the WCA market may increase the focus on serving rural customers with next generation Gigabit wireless connectivity, and should be compatible with sustained competition providing appropriate backhaul is available to make use of local access and wireless solutions. Commercial offers may also continue to be available.

The inclusion of a market for dedicated access including dark fibre in the terminating segment for access and backhaul, should ensure that the highest quality connections can be provided[26] and that competition on the basis of these connections is assured in areas where duplication of this infrastructure is not viable. This should help to ensure that the bandwidth and quality needs of rural businesses, public institutions and socio-economic drivers (including schools and hospitals) can be met, thereby fostering the development of digital applications and remote provision of services. Regulation of dedicated access in less competitive zones, is also important to support competition in provision of services to multi-site businesses. Together with WLA and/or wireless solutions, the inclusion of a market for dedicated capacity (including dark fibre) covering backhaul, should also serve to support competition in fixed and mobile broadband services in rural areas supporting the competitive deployment of 5G by Mobile Network Operators (MNOs) and other stakeholders (where relevant), as well as the provision of IOT/M2M services which may rely on this technology.

24 Software Defined Networking/ Network Function Virtualisation

25 See Nardotto et al. (2015) as it illustrates the impact of physical unbundling (in this case of the copper network) on competition in quality.. Techniques such as SDN/NFV could improve the degree of flexibility available to access seekers, but would not allow competition in the active equipment itself.

26 Where connections can be ordered at a wholesale level “on demand” with cost recovery of excess construction charges

Although the removal of markets for WCA and call termination may result in some administrative cost savings, these are not expected to be significant, and may be counteracted by the resources that may be needed to better target regulation through the geographic segmentation of the remaining markets.

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Abbreviations

ADSL	Asymmetric digital subscriber line
API	Application programming interfaces
AR	Augmented reality
ARPU	Average revenue per mobile user
BB CRD	Broadband Cost Reduction Directive
BEREC	Body of European Regulators for Electronic Communications
BREKO	German Broadband Association
CDF	Cumulative distribution function
CEE	Central and Eastern Europe
CI	Contemporary Interfaces
CPE	Customer-premises equipment
CPNP	Calling Party Network Pays
DEA	Danish authority Energy Authority
DOCSIS	Data Over Cable Service Interface Specification
DSL	Digital Subscriber Line
DSLAMs	Digital Subscriber Line Access Multiplexer
DWDM	Dense wavelength division Multiplex
EECC or Code	European Electronic Communications Code
eMBB	Enhanced Mobile Broadband
EMF	Electromagnetic fields
ERP	Enterprise resource planning
EU	European Union
FCDP	First concentration or distribution point
FFTH	Fibre to the home

FTTC	Fibre to the Cabinet
FTTdp	Fibre to the distribution point
FWA	Fixed wireless access
GSM-R	Global System for Mobile Communications – Railway
HPC	High performance Computing centres
HQA	High quality access
IaaS	Infrastructure as a service
IAB	Integrated access and backhaul
IMS	IP Multimedia Subsystem
IOT	Internet-of-Things
IRU	Indefeasible Rights of Use
ISDN	Integrated Services Digital Network
ISPs	Internet Service Provider
LLU	Local loop unbundling
LLVA	Lower Level Voice Access
LoRa	Low power – long range transmission system
M2M	Machine-to-Machine
MANO	Management and Orchestration
MBB	Mobile broadband
MDF	Main distribution frame
MNOs	Mobile Network Operators
MPoP	Metropolitan Points of Presence
MTR	Mobile termination rates
MVNOs	Mobile virtual network operator

NFV	Network Function Virtualization
NGA	Next Generation Access
NRAs	National Regulatory Authorities
N-REN	National Research and Education Networks
ODF	Optical fiber distribution frame
OTN	Optical Transport Networks
OTT	Over-the-top
PaaS	Platform as a service
PIA	Physical Infrastructure Access
PMx	Primary rate multiplex lines
POI	Points of Interconnection
POTS	Packet-Optical Transport System
PPDR	Public protection and disaster services
PSTN	Public switched telephone network
PtMP	Point-to-Multipoint
PtP	Point-to-Point
QoE	Quality of experience
QoS	Quality of service
RAN	Radio access network
RCS	Rich Communications Services
RTV	Radio and television
SaaS	Software as a service
SDN	Software Defined Networking
SDU	Service data units

SLU	Sub-loop unbundling
SMP	Significant Market Power
SOHOs	Small Offices and Home Offices
TKK	Telekom-Control-Commission, Austrian National Regulatory Authority
UCC	Unified Communications and Collaboration
URLLC	Ultra-reliable low latency communication
VDSL	Very high speed Digital Subscriber Line
VHC	Very High Capacity
VoB	Voice-Over-Broadband
VoIP	Voice over the Internet
VoLTE	Voice-over-LTE
VR	Virtual reality
VULA	Virtual Unbundled Local Access
WCA	Wholesale central access
WDM	Wave length division multiplexing
WE	Western Europe
WLA	Wholesale Local Access
WLR	Wholesale line rental
xDSL	Digital subscriber line, where "x" is used to collectively summarize DSL technologies
ZB	Zettabytes

1 Introduction

Since the last Recommendation on Relevant Markets was adopted in 2014, significant new technologies and services have entered the mainstream and new players have entered the market, while others have adapted their business models. This period has also seen new models of co-operation and a shift in some cases towards commercially negotiated wholesale agreements as an alternative to regulated access. These developments have led to changes in competitive dynamics and in the structure of some electronic communications markets.

The EC Recommendation on Relevant Markets provides guidance to National Regulatory Authorities (NRAs) in identifying electronic communications markets within their jurisdiction which are susceptible to ex ante regulation. NRAs are required under the terms of the Electronic Communications Code to take utmost regard of this Recommendation when defining markets in their jurisdiction.

The Electronic Communications Code requires the Commission to review the 2014 Recommendation on Relevant Markets by 21 December 2020.[27] This study provides a quantitative and qualitative analysis of EU electronic communications markets, to assist in determining whether changes may be needed to the current Recommendation.

The study is structured as follows:

- Chapter 2 describes current and future technological developments
- Chapter 3 considers market developments and emerging business models across the value chain for electronic communications and digital services
- Chapter 4 discusses regulatory and legal developments
- Chapter 5 considers market definitions for relevant markets associated with broadband and high-quality access, and applies the three criteria test to these markets
- Chapter 6 analyses fixed and mobile voice markets and the associated markets for fixed and mobile termination
- Chapter 7 outlines and compares the impact of various options for the definition of relevant markets on stakeholders, as well as on the development of VHC networks, competition, consumer welfare and the single market

The analysis is based on a review of ex ante cases and legal judgements and market data from public sources and IDATE as well as data provided by NRAs in October 2019, in response to a questionnaire distributed by the study team. In addition, the study team

27 Art. 64(1).

analysed responses to the public consultation organised by the European Commission in connection with the review of the Recommendation and conducted more than 20 interviews over the period between September 2019 and March 2020. Preliminary findings were presented at workshops held with BEREC in January 2020 and with stakeholders in March 2020, and written feedback was also invited.

2 Current and future technological developments

In this chapter, we consider current and future technological developments in order to understand to which degree different fixed and wireless technologies might substitute for each other in the medium term, and what are the expected characteristics and capabilities of different forms of wholesale access that may be provided in the coming years.

2.1 The relevance of technological developments in the field of market analysis

In the context of a study to identify markets susceptible to ex-ante regulation an understanding of the technological dimension is of importance to assess the capabilities of replacement and functional equivalence that alternative technologies may represent. In this assessment, it is important to evaluate the performance of these technologies to determine the type and degree of replacement that may be possible for end-users. From a regulatory standpoint, it is also important to evaluate what types of access can be provided via different technologies and the degree of freedom a wholesale access seeker may have when designing its own product using the wholesale input.[28]

While a technological comparison can indicate the degree to which different technical solutions may be functionally equivalent at the service level, other facts such as ease and cost of deployment, ease of switching and price will also determine whether they become substitutes in practice.

As the time frame of the study concerns the period 2020-2030, we have provided an assessment of how current technologies may evolve during the study period and whether the introduction of new technologies are likely within this period. The potential withdrawal of legacy technologies should also be considered as that may impact the range of options that are available to consumers in a given market.

28 See European Commission (2014a), with Explanatory notes on the EC recommendation on relevant product and services markets. In case of physical unbundling of passive infrastructure as wholesale input is no longer feasible for technical or economic reasons, virtual unbundled products may substitute the unbundled products, which grant product definition freedom close to the unbundled products. See also Plückebaum and Godlovich (2018).

Technologies in and by themselves can also influence the degree of retail competition that is possible in cases where there are a limited number of infrastructures. For instance, the degree to which a particular service is tied to a particular technology or the degree to which technologies can be physically unbundled or can allow for a variety of virtual services to be offered can impact the degree of competition that is possible via wholesale access, as well as influencing whether a wholesale access seeker would consider two wholesale products to be functional substitutes.

The way technologies allow for sharing may impact the degree of competition positively or negatively and thereby affecting the need for intervention. On the other hand, sharing may make the economic deployment of networks more feasible, which may increase diversity and improve the prospects for sustainable competition.

2.2 Technological characteristics and the implications for data rate and quality

When comparing technologies with each other, it is necessary not only to consider headline indicators such as data rates, but also other parameters which may affect how the technology may function in practice and for which purposes it may be used.

2.2.1 Performance

The performance of e-communications access technologies is primarily determined by the physical characteristics of the medium that is being used: twisted pair copper in an unshielded or shielded manner, coax, optical fibre or radio waves. The performance is subsequently determined by the way the medium is accessed and the efficiency of the transmission protocols used. The length of the access line or link plays an important role in terms of attenuation of the signal and crosstalk of one signal into the other in case of unshielded copper. The standards that cover the various transmission protocols define the data rates under specific conditions (profiles). In practice the data rate experienced by the end-user may be lower than what is considered technically possible. Furthermore, advertised rates may differ from the actual rates delivered.

The next consideration is the way the capacity of the medium is allocated, either to one user or shared across multiple users. The modularity of the sharing is determined by the system design. The degree of sharing is determined by the way the operator deploys the technology and sets the system parameters. The degree of sharing can be adjusted over time within the system boundaries. Typical shared media are the coax cables and radio links, as well as fibre links in a point-to-multipoint topology fibre plant. The actual end-user experience also depends on the traffic profiles of the users that share the group. See also the section on sharing below.

Furthermore, the use of data compression technologies plays a role, the efficiency of the application protocols, as well as the use of secure communications (encryption). The sensitivity of the medium regarding external electromagnetic interference also plays a role, especially regarding unshielded copper pairs and radio links. What end-users experience in terms of quality of service or quality of experience is affected by all of these factors.

In the early days of e-communication network developments, the type of technology used determined the type of service provided and its performance. The way the technology was applied was optimized for that particular service use. For example, telephony relied on twisted pair copper cables in the access network. Radio and television (RTV) signal distribution was based radio waves and on coax cables. Since the 1990s the transmission in the access network has become digital and standardized on the use of data packets and the application of the TCP/IP protocol stack. This has decoupled the applications from the underlying transmission medium. As a result, the key performance parameter has become the data rate, also called speed, of the network access technologies, typically expressed in Mbit/s, followed by transmission delay, jitter and packet loss.

As data communication can be very skewed in terms of the difference in the amount of data transferred in the downlink (from a computer datacentre to the end-user) and the amount transported in the uplink (from the user to the datacentre) the performance is typically indicated for both directions, with the downlink data rate as leading, e.g. 1 Gbit/s in the downlink and 0.5 Gbit/s in the uplink is denoted as 1/0.5 Gbit/s. In advertisements one often only finds the downlink data rate.

2.2.2 Sharing

In a copper environment, typically dedicated wire pairs were assigned to individual customers up to the switch location. The first example of line sharing in the telephone industry has been multiparty lines in rural areas in the 1930s. In the case of the RTV cable distribution systems, introduced in the 1970s, the same signal is distributed (broadcasted) to all end-users who tune to a particular channel of choice. An upstream and downstream individual transmission capability was introduced in the 1990s with the DOCSIS standard allocating timeslots for the individual communication on the shared medium. The degree of sharing was determined by the transmitted signal power level and receiver sensitivity. In passive optical systems, either individual fibres are used between the end customer and the central aggregating switch or, in a fibre sharing mode, splitters are used to divide the signal to multiple end-users, in groups of 16 up to 264 end-users. Couplers are used to combine the signals in the uplink. As with DOCSIS, electronic equipment is required to allocate the shared capacity to the individual communication relations of the end users. The electro-magnetic spectrum used for radio links is by nature a shared medium. Through the allocation of channels and through various modulation techniques, multiple users can be served within the same radio frequency band. The up and down links are separated in frequency

(frequency division duplex) or in time (time division duplex). The cellular principle allows the re-use of frequencies at a distance.

Another type of sharing occurs where the access lines interconnect with the core network. Here a number of access lines is aggregated by an electronic communication system and shares a number of backhaul or core circuits, whereby the latter are dimensioned based on the traffic intensity of the former during busy hour. This is sometimes referred to as the overbooking ratio.

For mobile networking (e.g. 4G and 5G) the access rights to the use of specific radio frequency bands are typically assigned through an auction. These rights are exclusively assigned to a mobile network operator. End-users share the assigned spectrum when using mobile services. Certain parts of the spectrum may be allocated for special use, e.g. GSM-Rail, PPDR (public protection and disaster services) or local exclusive use, as in the case of Private-GSM or Private-LTE.

Other frequency bands have been allocated to unlicensed, non-exclusive use. For instance, for the use of short-range devices, including Wi-Fi and Bluetooth. Medium range systems, such as LoRa (low power – long range transmission system used for IoT), also make use of unlicensed bands. All users then compete for radio transmission capacity in these bands, typically using protocols that are robust to interference and that are polite with respect to other users.

To reduce the capital outlay required for the build-out of a next generation of mobile technology, e.g. 4G to 5G, mobile network operators may share passive infrastructure, such as ducts, fibre cables and antenna masts.[29] They sometimes also share base stations and may share other active network core equipment. The highest level of sharing in this regard is roaming, which can be considered a form of access on the network of another operator.

2.2.3 Quality of service (QoS) and quality of experience (QoE)

The technical performance of a communication system is typically denoted in quality of service parameters. The data rate is typically displayed as the primary parameter. However, depending on the circumstance, other parameters can play an equally or more important role. The degree of packet loss is important (due to errors in the transmission or due to overload of a connection resulting in packets being delayed or discarded) as are jitter and fading (degree of variability in signal timing). For time sensitive applications latency (signal delay/round trip delay) plays an important role. Latency is in part determined by the medium that is used (copper, radio waves, optics), by the number of medium conversions, e.g. from electrical to optical signals and vice versa, and by the encryption/decryption used, as well as by the number of packet processing hubs in the connection. However, the way the end-user

29 See BEREC (2018b).

experiences the technical quality largely depends on how the deficiencies of the transmission medium are resolved through error correction techniques. Therefore, in practice a more relevant parameter for transmission errors is the packet loss or frame loss. Furthermore, the type of application determines what is important (e.g. in terms of response time, voice or image quality).

Expectations regarding quality are shifting upward over time as the demands of services provided increase, e.g. in terms of TV quality, from 4k-UHD to 8k. Last but not least, an important factor is the reliability or availability of the communication. In the core network, typically redundancy is built-in such that a single failure does not bring the system down. However, residential access is not protected, while for business connections multi-homing and alternative routing may be provided.

2.3 Context and timeframe

The period to be considered in this study is 2020-2030. A ten-year period fits well with an infrastructure industry that is hardware based and characterized by deep investments and long payback times. The period nicely coincides with the introduction of a next generation of mobile technology 5G, from 2019-2020 onward. Following the regularity of new generations in the mobile industry, the next generation 6G may be expected around 2030.

In the area of wired technologies no such stepwise architectural change is expected. The access network infrastructure is in many cases still based on copper pairs, installed 40^{+} years ago. The new fibre cables also have an expected life-time beyond 40 years. In contrast, the transmission technologies that are using these infrastructures are subject to a much faster pace of innovation, typically with a technology lifetime of 5 years or less.

In a software-driven industry the pace of renewal is much faster. This implies that for the largely software defined services being provided over the e-communications infrastructure (Over-The-Top services), more cycles or a more dynamic environment is to be expected within the study period.

The policy objectives set in the Digital Agenda for completion in 2020 were: all Europeans to have access to the Internet with data rates above 30 Mbit/s and 50+% of European households will have subscribed to Internet access with data rates above 100 Mbit/s. The policy objectives set for the Gigabit Society for completion in 2025 are: all schools, transport hubs and main providers of digital services as well as digitally intensive enterprises should have access to 1/1 Gbits; all European households should have access to networks of at least 100 Mbit/s which can be upgraded to 1 Gbit/s; all urban areas and major roads and railways should have uninterrupted 5G wireless coverage.[30] For the final part of the study period 2025-2030 no policy targets have been set thus far. It may be expected that the trend

30 European Commission (2019a).

towards higher and more symmetric bandwidth requirements continues, as well as the demand for higher degrees of quality of residential, business and public sector services.

Moreover, evolving requirements associated with the Internet of Things and digital applications for industry and public services are likely to increase the need for widespread connectivity (covering more remote areas and transport paths as well as major conurbations), which may in some cases need to be wireless or mobile. There may also be further demand for guaranteed quality of service to meet the requirements of specific industrial applications, which may need to span across networks.

Our assessment of technological developments is underpinned by an analysis of the underlying core technologies, such as computing and signal processing, optical transmission and radio transmission. An understanding of these factors is important in determining whether trends that can be observed in the current decade are likely to hold into the next.

The key trend that has determined the developments in the ICT world is Moore's Law, predicting the performance improvement of integrated circuits. This Law is expected to come to an end in 2021 as the downscaling in size of integrated circuits is reaching its limit in terms of the minimum number of atoms required for discrete logic functions. The alternative avenues are quantum computing and optical computing. Both are still in an early phase of development.

In the field of copper and radio transmission the technological developments are approaching the Shannon Limit, the limit of information that can be transmitted in the presence of noise. Optical transmission is also approaching the Shannon limit per wavelength in use. However, there is still space for growth, which supports the notion of fibre optics as a more future-proof technology. A technology that, at introduction, starts with a significantly higher data rate than any other access technology.

A recent initiative of the European Commission is the deployment of High performance Computing centres (HPC) based on Exa-scale Systems, connected by a Terabit network infrastructure with the N-REN (National Research and Education Networks) of the member states. It is envisaged that these HPCs could provide access to the computation infrastructure not only for the science and public research community, but also to other stakeholder groups such as hospitals, large, medium and small enterprises and even SOHO and student homes. These publicly funded computer centres could be complemented by privately financed cloud centres with similar characteristics, accessed by a common network. Such networks would require transparent fibre access based on wavelength combining transmission systems which allow switching such capacities on demand. From today's point of view OTN (Optical Transport Networks) nodes could be enhanced to support such demand.[31]

31 Ecorys et al. (2020).

2.4 Comparing the performance and quality of access technologies

The following table shows in summary form the state of the art in terms of the various access technologies and their performance. The dates of introduction have been added to facilitate an understanding of how technologies have evolved with a view to identifying potential trends for the future.[32] We also indicate to what extent the different technologies depend on the deployment of fibre towards the customer, as this is an important factor affecting investment requirements and the prospects for viable duplication of infrastructure.

The column denoted ‘Shared access medium’ indicates whether it concerns connections shared among multiple end-users (Point-to-Multipoint – PtMP) or a non-shared connection (Point-to-Point – PtP). The column denoted ‘QoS mgt’ refers to the ability to manage the QoS levels. Three cases are distinguished: (1) fixed levels, through network engineering and operational set-up, (2) fixed levels through network engineering and operational set-up, but varying in practice as a result of sharing the access medium; (3) boundaries set through network engineering and operational set-up, with the levels manageable through QoS controls as part of the Management and Orchestration (MANO) function. The column ‘BB target 100 Mbit/s’ and the column ‘Ultrafast BB upgrade to 1G’ refer to the Gigabit Society targets. To achieve the 1Gbit/s target, these upgrades may have an impact on the maximum sharing ratio that can be applied and hence have a consequence for the costs.

Further details concerning the development, standardization and architectures associated with these technologies is provided in Annex 2. Note that two wireless technologies are not included in the table: WiMAX (IEEE802.16 Rel. 1 standard introduced in 2001) has been deployed in certain areas in Europe and at a much larger scale in for instance the USA. Meanwhile it has been eclipsed by the introduction of LTE. Satellite communication, is not included as it typically concerns niche applications, such as communication with ships, communication on airlines, deep rural and extreme remote sites, for example oil rigs. The revival of low earth orbiting satellites, such as the SpaceX Starlink initiative, OneWeb and IridiumNEXT, following the demise of the earlier generation of Iridium and Globalstar, is not considered to become a functional equivalent in the timeframe of this study.

32 Author, adapted and extended from Lemstra (2016); WIK (2016a); Lemstra, Cave and Bourreau (2017) with updates for recent developments.

Table 2-1: An overview of the performance of technologies

Trans-mission technology	Year of specifi-cation release/ intro-duction	SDO – Specifi-cation	FttX	Data rate downlink peak in Mbit/s	Data rate uplink peak in Mbit/s	Shared access medium	QoS mgt	BB target 100 Mbit/s	VHC BB upgrade to 1G
Twisted pair copper									
ADSL	1999	ITU G.992.1	-	8	1.3	n	1	n	N
ADSL2	2002	ITU G.992.3	-	12	1.3/3.5	n	l	n	N
ADSL2+	2003/2008	ITU G992.5	-	24	1.4/3.3	n	1	n	N
VDSL	2001	ITU G.993.1	FttC	55	3	n	1	n	N
VDSL2	2006	ITU G.993.2[3]	FttC	50	16	n	1	n	N
VDSL2 G.Vector	2010	ITU G.993.5	FttC	90	40	n	1	n	N
VDSL2 35b Supervect.	2018[5]	ITU G.993.2	FttC	300	100	n	1	y	N
G.fast (106 MHz)	2014	ITU G.9701	FttB/dp	500[4]	500	n	1	y	?
G.mgfast	2020-2022	ITU SG15[6]	FttB/dp	2,500/ 5,000	2,500 - 5,000	n	1	y	Y
Coax									
DOCSIS 1.0	1997	CableLabs	FttCMTS	40	10	y	2	n	N
DOCSIS 1.1[10]	2001	CableLabs							
DOCSIS 2.0	2002	CableLabs	FttCMTS	40	30	y	2	n	N
DOCSIS 3.0	2008	CableLabs	Fttdp/hh	1,200	200	y	2	y	N
DOCSIS 3.1[7]	2013	CableLabs	Fttdp/hh	10,000	1/2,000	y	2	y	Y
DOCSIS 4.0	2019	CableLabs	Fttdp/hh	10,000	10,000	y	2	y	Y
Optical fibre									
APON	1999	ITU G.983	FttH	155	155	y	2	n	N
BPON	2003	ITU G.983+	FttH	622	155	y	2	n	N
GPON	2004	ITU G.984	FttH	2,488	2.488	y	2	y	N
XG-PON NG PON1	2009	ITU G.987	FttH	10,000	2,500	y	2/3	y	Y
XGS-PON	2017	ITU G.9807	FttH	10,000	10,000	y	2/3	y	Y

Trans-mission technology	Year of specifi-cation release/ intro-duction	SDO – Specifi-cation	FttX	Data rate downlink peak in Mbit/s	Data rate uplink peak in Mbit/s	Shared access medium	QoS mgt	BB target 100 Mbit/s	VHC BB upgrade to 1G
XGS-PON+	2020	ITU	FttH	25,000	25,000	y	2/3	y	Y
NG-PON2 TWDM PON	2014 2019	ITU G.989 Edition 1.0 Edition 2.0	FttH/E	(1-4) x 10,000 1-8x 1/2,5/ 10,000	(1– 8) x 10,000 1-8x 1/2.5/ 10,000	y	2/3	y	Y
1G-EPON	2004	IEEE802.3ah	FttH	1,250	1,250	y	2	y	N
10G-EPON	2009	IEEE802.3av	FttH	10,000	10,000	y	2	y	N
50G-EPON	2020	IEEE802.3ca	FttH	50,000	50,000	y	2	y	Y
100BASE-X[18]	2004	IEEE802.3ah	FttE	100	100	n	1	y	Y
1000BASE-X	2004	IEEE802.3ah	FttE	1,000	1,000	n	1	y	Y
10000BASE-X	2002	IEEE802.3ae	FttE	10,000	10,000	n	1	y	Y
CWDM	2002	ITU G.694.2	FttE	(1-18) x 10,000	(1-18) x 10,000	n	1	y	Y
DWDM	2018	ITU G.709[17]	FttE	155 – 100,000 (1-32)x 200,000	155 – 100,000 (1-32)x 200,000	n	1	y	Y
Radio waves	Licensed access								
2G-GPRS	1999	ETSI Rel. 98	-	0.085	0.0021	y	2	n	N
EDGE	2003	ETSI	-	0.237	0.059	y	2	n	N
EC-GSM-IoT	2017	3GPP Rel. 13	-	0.098	0.098	y	2	n.a.	n.a.
3G-UMTS	2000	ETSI Rel. 99 TR 101 111	-	0.144[12]/ 0.384/2.0	0.1/ 2	y	2	n	N
HSPA	2006/2007	3GPP Rel. 5/6	-	14.4	5.8	y	2	n	N
HSPA+	2008/2009	3GPP Rel. 7/8	-	21/42	11	y	2	n	N
4G-LTE	2009	3GPP Rel. 8	Fbackhaul	2x2MIMO 70 4x4MIMO 300	16QAM-2x10 22 64QAM 2x20 75	y	2/3	y	N
IMT Advanced	2010	ITU		1,000 10[15]					

Trans-mission technology	Year of specifi-cation release/ intro-duction	SDO – Specifi-cation	FttX	Data rate downlink peak in Mbit/s	Data rate uplink peak in Mbit/s	Shared access medium	QoS mgt	BB target 100 Mbit/s	VHC BB upgrade to 1G
NB-IoT	2017/2018	3GPP Rel. 13/14	-	0.025/ 0.079	0.062 /0.010	y	2/3	n.a.	n.a.
LTE-M	2017	3GPP Rel. 13	-	0.3/0.8[11]	1.0/0.37	y	2/3	n.a.	n.a.
4G-LTE Adv.	2011	3GPP Rel. 10	Fbackhaul	3,000	1,500	y	2/3	y	N
4G FWA[1]	2009/11	3GPP	Fbackhaul	50-150	20-40	n[2]	1	y	N
5G NSA NR[9] Rel. 15	4Q2017	3GPP TR 21.915	Fbackhaul	5,000	2,500	y	2/3	y	N
5G Rel. 15	2Q2019[8]	TR 21.915	Fbackhaul	10,000 50[16]	5,000 25[16]	y	2/3	y	Y
5G Rel. 16	2Q2020	TR 21.916	Fbackhaul						
5G Rel. 17	2Q2021	TR 21.917	Fbackhaul						
IMT2020	2020	ITU		20,000 100[15]	10,000 50[15]				
5G FWA	4Q2017	3GPP	Fbackhaul	10,000	5,000	n[2]	1	y	Y
Radio waves	Unlicensed access								
Wi-Fi	1997	IEEE802.11	-	2[13]		y	2	n	N
Wi-Fi	2000	IEEE802.11b	-	11		y	2	n	N
Wi-Fi	2000	IEEE802.11a	-	54		y	2	n	N
Wi-Fi 4	2009	IEEE802.11n	-	600		y	2	y	N
Wi-Fi 5	2013	IEEE802.11ac	-	1,300[14]/6,900		y	2	y	Y
Wi-Fi 6	2019-2020	IEEE802.11ax	Fbackhaul	4,800		y	2	y	Y
LoRaWAN	2015	Release 1.0	-	0.05	0.05	y	2	n.a.	n.a.

Legend: ***Year of specification release/year of introduction*** refers to the first release of the specification for the system as a whole; in case of mobile technologies it refers to the introduction date of the system at large. Typically multiple releases follow to enhance the system performance and extend the system's features. ***SDO:*** Standards Development Organization. ***FttX*:** Fibre to the Building or Basement / Cabinet / Cable Modem Termination System / distribution point / Enterprise / fibre used for backhaul / hand hole / Home / Premises. ***Data rates*** refer to the maximum rates stated in the specification where available, otherwise the data rate is based on literature sources. Actual product/system implementations may provide lower rates. Note that average and peak rates apply and that in shared media data rates in practice vary based on network engineering and actual traffic. ***n.a.:*** not applicable. ***QoS management*** refers to the ability to manage the QoS levels: (1) fixed levels, through network engineering and operational set-up, (2) fixed levels through network engineering and operational set-up, but varying in practice as a result of sharing the access medium; (3) boundaries set through network engineering and operational set-up, but levels manageable through QoS controls as part of Management and Orchestration function. ***Note 1:*** At the 1800 MHz band. ***Note 2*:** Individually engineered within shared frequency space. ***Note 3:*** Profile 8a through 8d. ***Note 4:*** Ratio downlink/uplink can vary between 90/10 and 50/50; at distances less than 100 m. ***Note 5:*** First deployment of Profile 35b by DT up to 250 Mbit/s. ***Note 6:*** Under study in ITU Study Group 15. ***Note 7:*** From DOCSIS 3.1 onward there are no regional specifications anymore (such as EuroDOCSIS). ***Note 8:*** 3GPP input to Initial technology submission by ITU-R-WP5D meeting #32, June 2019 and Detailed specification submission by ITU-R WP5D meeting #39, October 2020; reflects specification freeze date. ***Note 9:*** Non-stand-alone new radio, 5G radio on 4G core. ***Note 10:*** DOCSIS 1.1 adds VoIP to the DOCSIS1.0 specification. ***Note 11:*** Cat-M1 devices using HD-FDD respectively FD-HDD. ***Note 12:*** Data rates for respect. rural outdoor, max 500 km/h; suburban outdoor, max. 120 km/h; indoor/low range outdoor, max. 10 km/h. ***Note 13:*** Aggregate data rate. ***Note 14:*** current product max. ***Note 15:*** User experienced data rate. ***Note 16:*** IMT2020 ratio applied for peak to user experienced data rates. ***Note 17:*** Different product specifications by vendor apply, here the example of Nokia is used. Nokia 1830 PSS-4 through PSS-32 platforms, with an aggregated capacity ranging from 240 Gbit/s to 6.4 Tbit/s. Line rates 100Gbit/s to 500Gbit/s. Client rates from 155 Mbit/s through 100 Gbit/s, with a wide range of interface specifications. ***Note 18:*** Various specifications apply Short/Long/Extended/Z-ultra extended for the WAN environment.

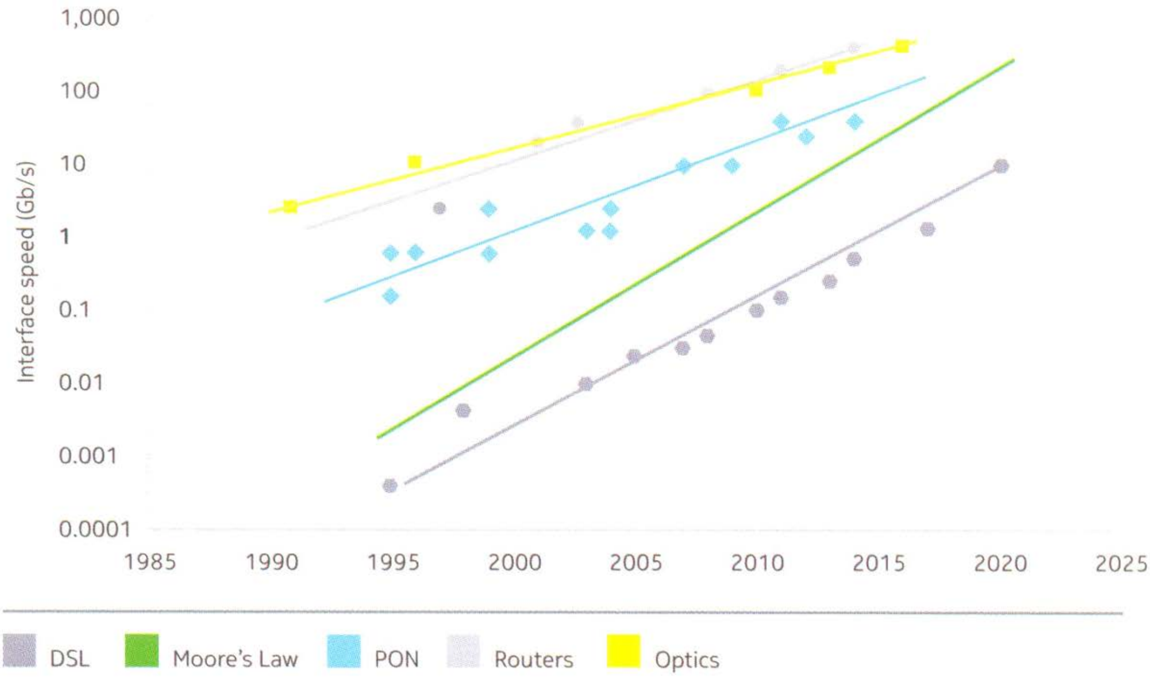
2.5 Summary of expectations regarding access developments for the study period 2020-2030

2.5.1 Trends in fixed and mobile performance

Reflecting on the past 20-25 years, all communication technology development trajectories show a steady exponential growth in terms of data rates over time. This can be explained mostly due to the performance improvement of the underlying silicon-based technologies, which is captured in Moore’s Law predicting a doubling in performance every 18-24 months. See Figure 2-1 for the evolution of fixed network technologies.[33] A further analysis is provided in Annex 2.

33 Weldon (2016).

Figure 2-1: Moore's Law and access and core network interface evolution



As the analysis shows, since 2015 the actual performance of silicon has started to taper off. Nonetheless, the performance of computing chips has remained robust, largely as a result of complementary engineering efforts, such as multiple cores on a single chip.

With the final node in terms of scaling down the size of the transistor is predicted to be reached in 2021, the engine underpinning the progress is running out of steam. The exponential curves are expected to level off, the impact will likely become noticeable in the second part of the study period, from 2025 onward.

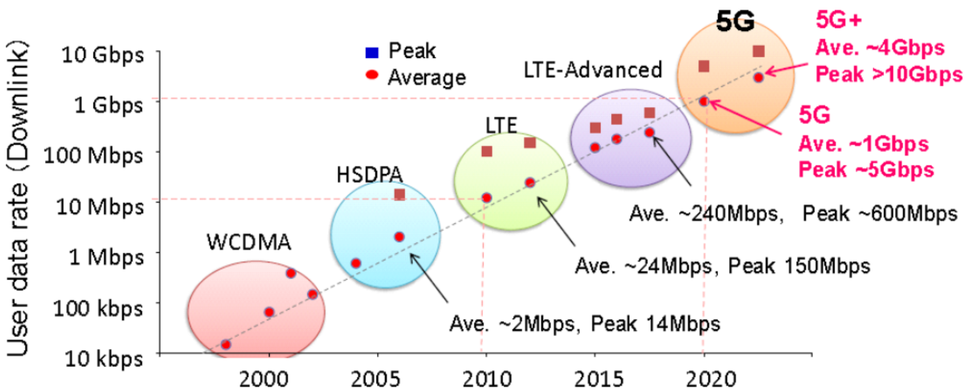
However, alternative computing technologies are expected to receive a boost as funding flows to these developments. As the analysis in Annex 3 shows, optical and quantum computing are still in an early phase of development. Nonetheless, both technologies promise to be very powerful. Optical computing in terms of the three dimensional space that can be used and quantum in terms of the dual status of the quantum bits and the simultaneous manipulation it provides. It is expected that from 2025 onward the use of optical and quantum computing will have an impact. Note that due to the complexity of 'managing' quantum bits the form factor is such that initially centralized computing is to be expected.

The developments in radio communication also reflect an exponential growth trajectory, see Figure 2-2.[34] In terms of deployment typically one generation has become mature (4G) and

34 Nakamura (2016).

is on a growth curve, one new generation (5G) is being introduced and one older generation (3G rather than 2G) is being phased out. In terms of the generation life cycle it should be noted that 2G-GSM reached its peak in deployment 25 years after its launch. Hence, growth of LTE-Advanced will continue well into the study period. Meanwhile, further releases of 5G may bring the performance closer to the IMT2020 objectives and likely beyond.

Figure 2-2: Data rates improvements toward 2020 and beyond



However, the technological developments in wireless have pushed the capabilities towards the Shannon limit,[35] see Figure 2-3.[36]

This means that higher capacities in mobile networks will need to be realized through more spectrum bandwidth at higher frequencies, extensive utilization of MIMO and densification of the network.

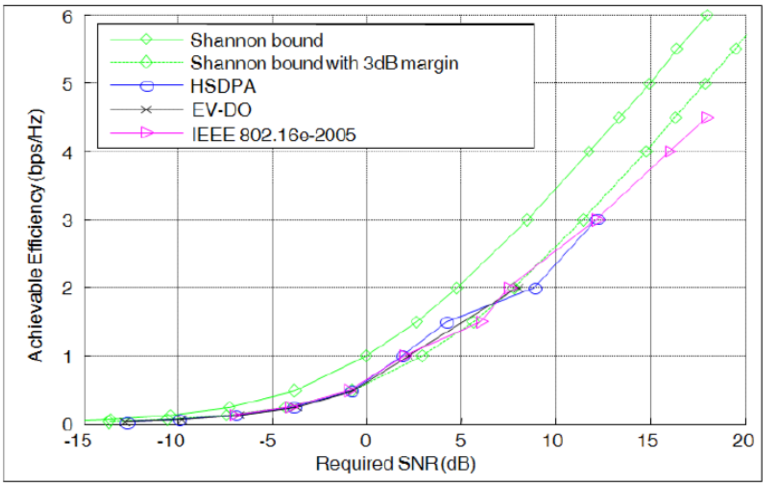
In a recent IEEE Network paper and a paper submitted to IEEE Magazine, the expectations for 6G have been explored. The expectations include the results from ongoing trends as well as results from new areas of research. In terms of ongoing trends we may expect support for higher data handling capacities by one or two orders of magnitude, the increasing use of AI to enable self-optimizing networks, which may lead to the realization of the "Mitola radio' also known as a full cognitive radio. More attention is also expected for more secure communications, including the use of cryptographic techniques. Enhanced support for applications will include augmented reality (AR) and virtual reality (VR) and a mix thereof. Furthermore, the support of haptic communication, i.e. adding the sense of touch. The 'third dimension' will be developed further to provide support for communication with drones, as well as the prospect of UAV (flying) base stations. New developments will include the use of smart reflective surfaces, large intelligent surfaces and new materials, including software-defined materials. Wireless power transfer and energy harvesting will also be pursued. In architecture terms 6G is expected to support different combinations of requirements, such as

35 The Shannon limit refers to the maximum amount of information that can be transferred across a communication channel, being constrained by the signal to noise ratio.

36 Rysavy Research (2017).

high reliability combined with high data rates and with low latency. Use will be made of sub-millimetre waves and THz frequencies for very short range communication. In terms of design, 6G will represent the co-design of end-to-end communication, control and computing functionalities.[37]

Figure 2-3: Shannon limit in relation to wireless systems



As described in the previous sections, multiple factors intervene between the underlying technologies and the end-user experience. There is the translation from specification into products and the deployment of these products. Furthermore, the engineering options available to the network operators (e.g. progressive deployment of optical) and the opportunity to tune performance characteristics (e.g. adjusting sharing ratios). Moreover, this process in terms of time interval and performance is influenced by the degree of competition in the market. The intervals involved range from 1-4 years. This suggests that in practical terms the current trends can be extended with a fair degree of confidence to the 2025 horizon. This coincides with the (new) five-year review period for the market analysis.

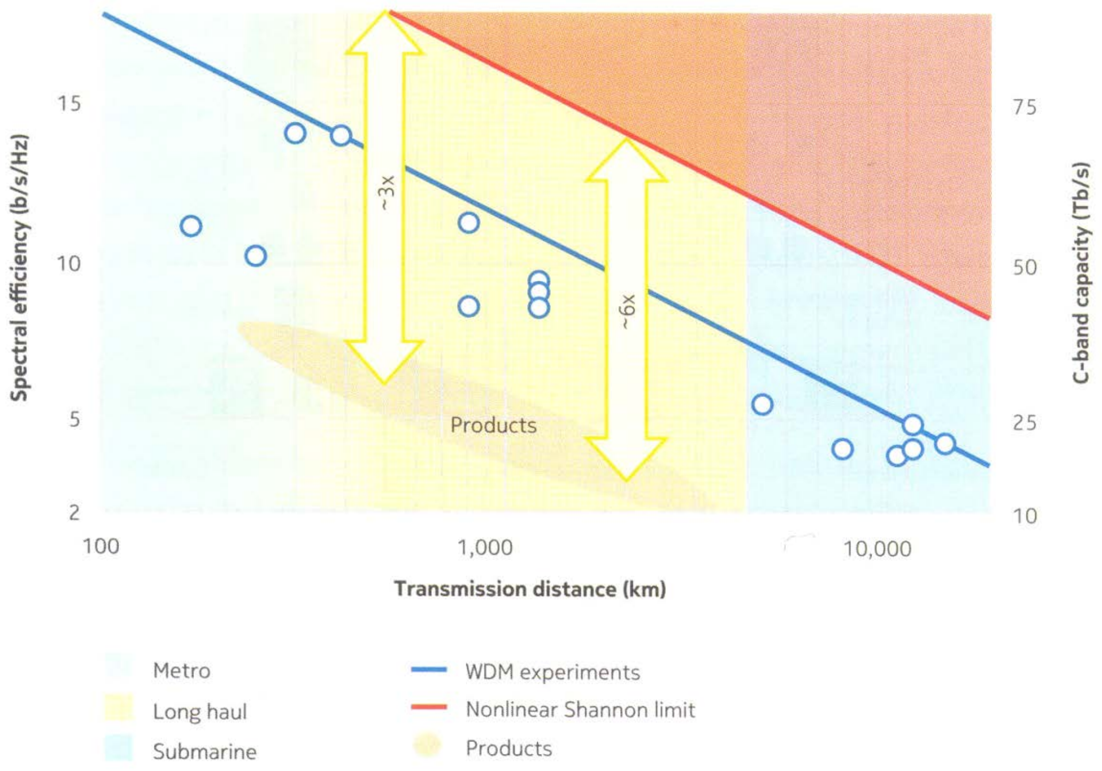
Considering the uncertainties that remain for the 2030 horizon, the use of scenarios is considered appropriate. A worst-case scenario would be a lack of progress, whereby the performance level attained in 2025 will become the performance level for the period 2025-2030. An intermediate-case is the further exploitation of the performance of the technologies deployed. For the fixed network this means the deployment of G.mgfast, DOCSIS 4.0 and NG-PON2, as well as 1000G Ethernet and switched OTN networks. For the mobile network this means the upgrade of the household target from 100/100 Mbit/s to 500/500 Mbit/s and the intensive user target from 1/1 Gbit/s to 2.5/2.5 Gbit/s, alongside the release of 5.5G as an intermediate step towards 6G. A best-case scenario would involve the utilization of the technologies to their theoretical maximum. This suggests an all-fibre environment with data

37 Saad, Bennis and Chen (2019) and Tariq et al. (2019). See also the discussion on cloud-integrated networking in Annex 1.

rates only constrained by the Shannon limit and wireless developments into the Terabit/s range. See Figure 2-4.[38]

In infrastructure industries with deep investments and long payback times, radical change does not happen overnight. Replacing the telecommunication access network cable infrastructure will require decades to complete. Hence, the period 2020-2030 can be considered a transition period where current day architectures determine the landscape in the beginning while virtualized architectures will have become dominant by the end of the period. The change will occur in an incremental way rather than through a ‘big bang’. For a considerable period, old and new technologies will coexist. Hence, in this period, regulators will need to take into consideration the ’old’ alongside the ‘new’, and moderate the path from one to the other.

Figure 2-4: Optical systems approaching the nonlinear Shannon limit



Innovation in current day technologies will remain important for network operators to improve services and reduce costs. These innovations typically enhance current functionality, but in various cases also allow different business models to be deployed. For instance, in the field of optical transmission, point-to-point topologies will allow for physical unbundling of optical access lines while wave length division multiplexing (WDM) will allow for unbundling of

38 Weldon (2016).

optical access networks based on different wavelengths.[39] Meanwhile, in the field of mobile technology, 4G already allows for ‘network slicing’ which means that a part of the network can be ‘set aside’ for particular user(s), such as the public protection and disaster relief sector. This is a first step on the way to full virtualization of mobile networks. Furthermore, 5G New Radio operating in the 3.5 GHz band is, as a first step, connected to the 4G core network. In a next release it will become stand alone and subsequently support operation in the 24 GHz through 52 GHz range.

Slicing will obviate the need to allocate dedicated radio frequency bands for PPDR (TETRA) and/or the rail sector (GSM-R), which in their transition towards broadband intends to adopt 4G/5G standards to benefit from economies of scale. The next generation of mobile 5G extends the slicing opportunity and adds QoS differentiation to meet the diverse needs of vertical industries and a broad variety of public sectors. Furthermore, it offers the opportunity to extend the current MVNO model to a vibrant wholesale-retail model.

2.5.2 Mapping current and future technologies to use cases

To provide an impression of how future demand may be served by future supply, WIK has developed a bandwidth demand forecast for residential fixed broadband access up to the year 2025.

The WIK market potential model projects future demand for bandwidth from residential customers on the basis of three parameters:

- The applications that will be used by residential customers in 2025 and their bandwidth requirements
- The user profiles (i.e. different types of customers) that are to be expected in the future, and the applications that each user profile is likely to use
- The population structure expected in 2025 and the distribution of user profiles among the population structure

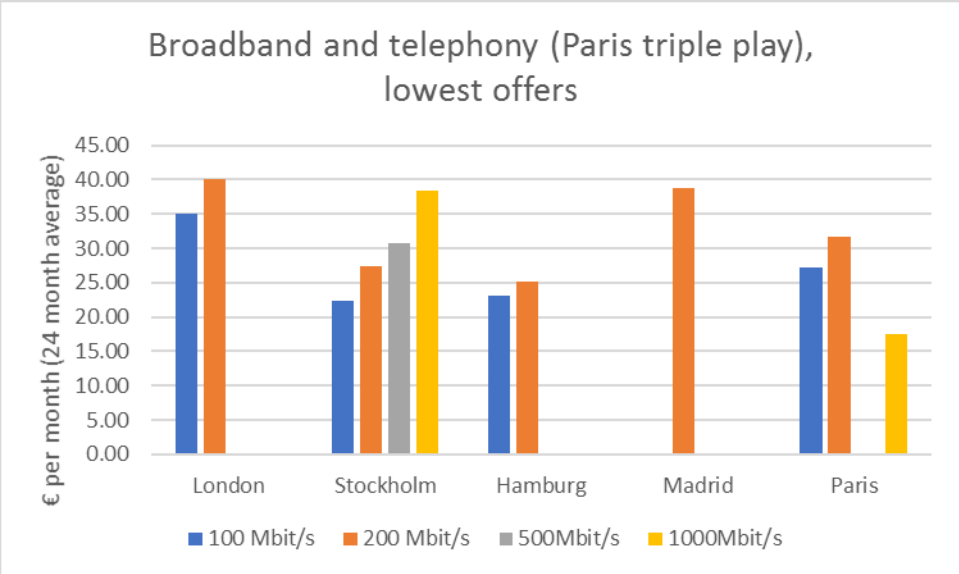
The model can then be used to assess which access technologies (as a minimum) in each category may be able to satisfy this demand.[40]

The model focuses on unconstrained demand without technical or budget restrictions in order to understand what services and applications could develop and which bandwidths customers would require in an ideal scenario in which gigabit capable infrastructure was available and priced at an affordable level. Although this may seem to be an idealised scenario, there is evidence that it is a relevant scenario in view of the cost of full fibre infrastructure and response by end-users to the availability of full fibre. Specifically, cost

39 WDM as ageneral term refers to all types of wavelength division multiplex systems, including DWDM, CWDM, and NG-PON2.
40 WIK (2017a).

models used by the Swedish regulatory authority PTS to assess the cost of copper and fibre access lines as well as cost models prepared by WIK, suggest that the use of fibre is the most efficient "modern equivalent asset" with which to construct access networks, and the cost per line from such a network does not significantly exceed that (and indeed may be less than the cost) of a newly built copper network.[41] As seen in the following chart, Gigabit connectivity is indeed available at affordable rates (comparable to rates for FTTC connections elsewhere) in cities such as Stockholm and Paris which have extensive fibre networks available.

Figure 2-5: Charges for broadband and telephony by speed, lowest offers, June 2017



Source: WIK-Consult based on operator websites[42]

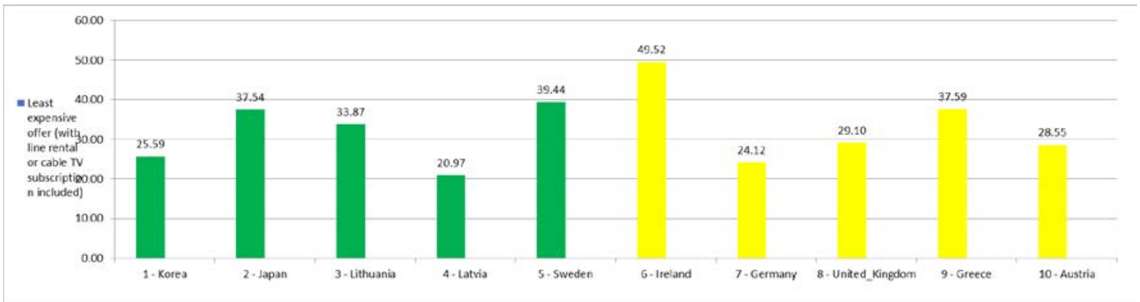
More generally, data gathered on fixed broadband prices for the European Commission in 2018 (see below), confirm that, especially in countries where fibre is prevalent and take-up is high (the first 5 countries displayed in the chart were those with the highest proportion of FTTH as % of total broadband according to the OECD in 2018), prices for Gigabit broadband are relatively low (between €20 and €40 per month), and comparable to prices charged for NGA broadband offers (between 30-100Mbit/s) in countries which have not yet achieved

41 Prior to its 2015 WLA market review, prices for fibre wholesale services in Sweden were cost-oriented following the LRIC+ cost standard. Cost-based charges for both fibre and copper-based services were determined through the same BU-LRIC+ model, which uses fibre technology (assumed to be the Modern Equivalent Asset) to calculate costs for both, with wireless technology assumed to replace copper in low density areas. PTS observed in 2011 that the use of fibre and wireless as the MEA for copper reflects the practice of operators building local access infrastructure in Sweden today and would minimise the forward-looking costs of the infrastructure. PTS estimated that the costs for fully unbundled access based on copper would be similar to or slightly higher than the costs for fully unbundled access based on fibre. The cost increase would mainly be dependent on the decrease in the number of active copper subscriptions – resulting in costs being recovered over a smaller user base.

42 Methodology and data sources described in WIK (2018) A tale of 5 cities https://www.stokab.se/Documents/Nyheter%20bilagor/A%20tale%20of%20five%20cities.pdf

significant fibre deployment such as Germany, Greece, Austria the UK and Ireland (shown in yellow on the chart), which range from €24-€49 per month.

Figure 2-6: Least expensive offer in € per month 2018: broadband Internet, Gigabit in green, NGA (30-100Mbit/s) shown in yellow



Source: WIK based on EC study, Fixed Broadband Prices in Europe 2018[43]

Meanwhile, from the demand side, there is evidence inter alia from the Palaiseau trial by Orange in France that when customers are switched from a copper network to a full fibre network, they consume significantly more bandwidth, with a notable increase in upstream bandwidth, which increased 8-fold in the Palaiseau case.[44]

Results from WIK's demand model as applied to Germany are shown in the table below. If the applications and broadband usage trends continue in this vein beyond 2025, FTTH coupled with indoor wireless solutions will be required to meet the needs of households and businesses towards the end of the study period. The WIK market potential model has been applied to several regions, including inter alia, the UK[45] and Flanders in Belgium.[46] A study of the results from these cases indicates that regional differences in the demand forecast result from different household structures and allocation of user profiles. A higher share of 3 or more person households drives broadband demand as does a higher share of user profiles which use home office/VPN, progressive TV and gaming.[47]

43 European Commission (2018a).
44 See discussion in WIK, IDATE, Deloitte (2016) for EC Regulatory, in particular access, conditions for network investment in Europe. See also European Commission (2016).
45 See WIK (2018a).
46 The assessment of the Flemish market was conducted in the context of a study for the Flemish Government on business models for VHC deployment in the region
47 Strube Martins, S and Wernick, C. (2019).

Table 2-2: The demand potential[48] for broadband household connections in Germany in 2025 in relation to the technologies that may fulfil the demand

<table>
<tr><th>Category and profile of HH in 2025</th><th>Number of households</th><th>% of HH</th><th>Access technologies[2]</th><th>Availability[1]</th></tr>
<tr><td>"Top Level Plus"-demand
1 Gbit/s and more downstream
600 Mbit/s and more upstream</td><td>~12.1 million</td><td>29.7</td><td>G.mgfast
1000BASE-X
50G-EPON
NG-PON2[3]</td><td>2022-2024
2006
2022
2021</td></tr>
<tr><td rowspan="2">"Top Level"-demand
500-1000 Mbit/s downstream
300-600 Mbit/s upstream</td><td rowspan="2">~19 million</td><td rowspan="2">46.6</td><td>High end:
G.mgfast
1000BASE-X
50G-EPON
NG-PON2[3]</td><td>2022-2024
2006
2022
2021</td></tr>
<tr><td>Low end:
G.fast
1000BASE-X
50G-EPON
XGS-PON+
NG-PON2[4]</td><td>2016
2006
2022
2022
2021</td></tr>
<tr><td rowspan="2">"Medium Level"-demand
150-500 Mbit/s downstream
100-300 Mbit/s upstream</td><td rowspan="2">~3.5 million</td><td rowspan="2">8.7</td><td>High end:
G.fast
DOCSIS 4.0
1000BASE-X
50G-EPON
XGS-PON+
NG-PON2[4]</td><td>2016
2021
2006
2011
2022
2021</td></tr>
<tr><td>Low end:
VDSL2 35b
DOCSIS 4.0
10G-EPON
XGS-PON
5G FWA</td><td>2020
2021
2011
2019
2019</td></tr>
<tr><td>"Low Level"-demand
up to 150 Mbit/s downstream
up to 100 Mbit/s upstream</td><td>~3 million</td><td>7.5</td><td>VDSL2 35b
DOCSIS 4.0
10G-EPON
XGS-PON
5G FWA</td><td>2020
2021
2011
2019
2019</td></tr>
<tr><td>No broadband / Refusal</td><td>~3.1 million</td><td>7.5</td><td></td><td></td></tr>
<tr><td>Total</td><td>~40.7 million</td><td>100</td><td></td><td></td></tr>
</table>

Notes: [1] Availability is taken as 2 years from the specification release date; [2] Assumes sharing ratio 1:32; [3] 4x10 Gbit/s; [4] 1x10Gbit/s.

Source: WIK-Consult demand model (see references above)

While the demand for SOHO and SME business customers may develop along those of residential customers with a higher level of quality, especially large accounts and

48 As discussed above, the model predicts potential demand on the basis of technological developments and expected household use in the absence of constraints. It thus does not reflect the availability of infrastructure or constraints that may apply as a result of higher prices being charged for higher bandwidths. This could be a reasonable steady state assumption in an environment where FTTH was widely deployed and offered on competitive terms

technologically advanced accounts cannot be satisfied by shared media technologies or infrastructures. They will require terabit access to cloud infrastructures and high performance computing centres based on a point-to-point fibre topology and switched OTN network nodes. Table 2-3 below provides an impression of how future business demand may be served by technology supply. The assumption is that businesses will require symmetrical supply. The projection of potential business demand has been created as an overlay on Table 2-2 above.[49]The proportions of businesses demanding these levels of bandwidth are likely to vary by country, as is the residential case, but the matching of degrees of demand to suitable technologies is likely to hold Europe-wide.

Table 2-3: The demand potential[50] for broadband business connections in Germany in 2025 in relation to the technologies that may fulfil the potential

Business profile in 2025	Number of businesses	% of buss.	Access technologies[2]	Availability[1]
“Top Level Plus”-demand 1 Gbit/s and more downstream and upstream	~300,000	8.3	1000BASE-X 50G-EPON NG-PON2[3]	2006 2022 2021
“Medium Level”-demand 150-500 Mbit/s downstream and upstream	~2.7 million	75.2	1000BASE-X 50G-EPON XGS-PON+ NG-PON2[4] 5G FWA	2006 2011 2022 2021 2018
“Low Level”-demand up to 150 Mbit/s downstream up to 100 Mbit/s upstream	~590,000	16.4	VDSL2 35b DOCSIS 4.0 10G-EPON XGS-PON 5G FWA	2020 2021 2011 2019 2018
Total	~3,59 million	100		

Notes: [1] Availability is taken as 2 years from the specification release date; [2] Assumes sharing ratio 1:32; [3] 4x10 Gbit/s; 4 1x10Gbit/s.

Source: WIK-Consult/Lemstra

As a new application area, IoT can be split into four segments: (1) Massive IoT, with examples such as smart metering, asset management and fleet management; (2) Broadband IoT, with drones/UAV, VR/AR; (3) Critical IoT, with automobile C-ITS, traffic safety and control, smart grid automation; and (4) Industrial Automation IoT, with collaborative robots, advanced automation and control. These four segments reflect different

49 Based on the assumption that medium and top-level business needs have been symmetrical from the outset, a transition to G.fast/G.mgfast or DOCSIS 4.0 at a later point in time is very unlikely, as it would imply a transition from fibre to coper-based solutions.

50 As discussed above, the model predicts potential demand on the basis of technological developments and expected business use in the absence of constraints. It thus does not reflect the availability of infrastructure or constraints that may apply as a result of higher prices being charged for higher bandwidths. This could be a reasonable steady state assumption in an environment where FTTP was widely deployed and offered on competitive terms

requirements and are supported by different cellular solutions, see Table 2-4.[51] Industrial automation in particular, typically operates in electromagnetically noisy environments requiring highly secure transmission protocols. Next to cellular solutions, IoT is supported by wireless systems operating in unlicensed frequency bands, such as LoRaWAN, Sigfox, Zigbee, Wi-Fi and Bluetooth.

Table 2-4: The market segments of IoT in relation to cellular technologies

IoT segments and characterization	IoT device characterization	Access technologies[2]	Availability[1]
Massive IoT High volume, low complexity devices; infrequently sending or receiving messages; often under challenging radio conditions; battery powered;	NB-IoT devices (200 kHz bw; half duplex; extreme coverage; high latency; data only)	EC GSM-IoT Rel. 13 NB-IoT Rel. 13/14 5GNR Rel. 15-17	2019 2019/20 2019-2023
	LTE CAT-M devices (1.4/5 MHz; half duplex; mobility and positioning support, higher throughput, voice connectivity)	LTE-M Rel. 13	2019
Broadband IoT Lower latency, higher data rates; extended range;	LTE coverage extension mode; enhanced battery life mode; latency 10 ms; Expanded capabilities through 5G NR; latency 5 ms	LTE/LTE-M 5GNR (NSA) Rel. 15 5GNR (SA) Rel.15	2011/19 2019 2021
Critical IoT Very low latency 5-20 ms end-to-end; high reliability 99.9999%; WAN and LAN;	5GNR URLLC; FDD/TDD devices; low, medium, high and very high frequency bands; optimization based on trade off data rate, latency, reliability and range	5GNR Rel. 16	2020-2022
Industrial Automation IoT Private wireless networks; mixture of massive, broadband and critical IoT	5G URLLC plus TSN (Time Sensitive Networking) control layer; support native Ethernet	5GNR Rel.16 5GNR+TSSN Rel. 17	2022 2023-2024

Note: [1] Availability is taken as 2 years from the specification release date.

Source: WIK-Consult/Lemstra

For an appreciation of the various needs of fronthaul and backhaul Table 2-5 below provides and overview in relation to the technologies that may provide for the needs specified. See for the technical background Annex 2.

51 Zaidi, Hussain & Kuhlins (2019).

Table 2-5: The fronthaul and backhaul needs in relation to technological supply

Type of fronthaul/ backhaul	Segment characterization	Backhaul/fronthaul technologies[2]	Avail-ability[1]
PSTN and Cable network backhaul	**A portfolio of access systems:** VDSL2 VDSL2-35b G.fast G.mgfast DOCSIS 3.0 DOCSIS 3.1 DOCSIS 4.0	**A portfolio of optical solutions:** 100BASE-X 1000BASE-X 10,000BASE-X	2006 2006 2006
4G/5G backhaul 2025[3]	**Mixed cellular environments** Urban: 600 Mbit/s – 20 Gbit/s <10 ms	**MW solutions:** 6-13 GHz band (224 MHz) 2 Gbit/s 16-23 GHz band (112 MHz) 1 Gbit/s (2x224 MHz) 4 Gbit/s E-band (78-80 GHz, (1-19)x250 MHz) (1-19)x1 Gbit/s	Current Current Current 2007/2015
		Optical solutions: NG-PON2 1G-EPON 10G-EPON 50G-EPON 1000BASE-X 10,000BASE-X	2016/2021 2006 2011 2022 2006 2006
	Mixed cellular environments Suburban: 300 Mbit/s – 5 Gbit/s <10 ms	**MW solutions:** 6-13 GHz band (224 MHz) 2 Gbit/s 16-23 GHz band (112 MHz) 1 Gbit/s (2x224 MHz) 4 Gbit/s E-band (78-80 GHz, (1-19) x250 MHz) (1-19)x1 Gbit/s	Current Current Current 2007/2015[4]
		Optical solutions: NG-PON2 1G-EPON 10G-EPON 1000BASE-X 10,000BASE-X	2016/2021 2006 2011 2006 2006
	Mixed cellular environments Rural: 100 Mbit/s – 600 Mbit/s <10 ms	**MW solutions** 6-13 GHz band (224 MHz) 2 Gbit/s 16-23 GHz band (112 MHz) 1 Gbit/s	Current Current
		Optical solutions: NG-PON2 1G-EPON 1000BASE-X	2016/2021 2006 2006
	In-band wireless	LTE 5GNR	2011 2019

Type of fronthaul/ backhaul	Segment characterization	Backhaul/fronthaul technologies[2]	Avail-ability[1]
Cellular fronthaul	CRAN 10-25 Gbit/s <75µs	E-band (78-80 GHz, (1-19)x250 MHz) (1-19)x1 Gbit/s	2007/2015[4]
	VRAN(DRAN) 1-10 Gbit/s <5ms	E-band (78-80 GHz, (1-19)x250 MHz) (1-19)x1 Gbit/s NG-PON2 1x10 Gbit/s 10000BASE-X	2007/2015[4] 2016/2021 2006
	VRAN (CRAN) 10-25 G/sector <75µs	E-band (78-80 GHz, (1-19)x250 MHz) (1-19)x1 Gbit/s NG-PON2 (1-3)x10 Gbit/s 10000BASE-X	2007/2015[4] 2016/2021 2006
FWA backhaul	5GFWA; 10-40Gbit/s per site	E-band (78-80 GHz, (1-19)x250 MHz) (1-19)x1 Gbit/s NG-PON2 (1-4)x10 Gbit/s 10000BASE-X	2007/2015[4] 2016/2021 2006

Notes: [1] Availability is taken as 2 years from the specification release date; [2] Assumes sharing ratio 1:32; [3] Estimates from Ericsson (2018a). The ETSI White Paper on “Microwave and millimetre-wave for 5G transport” distinguishes 4 site types with a similar overall range (< 2Gbit/s - > 10 Gbit/s). (ETSI ISG mWT, 2018); [4] First and second generation equipment (Asif, 2015); MW abbreviates Microwave directed Radio

Source: WIK-Consult/Lemstra

2.6 Potential for substitution amongst technologies

2.6.1 Potential technical substitutes for fixed telephony

The introduction of 2G in the early 1990s provided a first functional alternative to fixed telephony. Although the quality of fixed telephony connection was much better than the mobile connection and call prices were lower, end-users started to prefer mobile for the benefit of convenience; the nationwide coverage provided, i.e. ‘telephony anywhere’. However, at least initially, the introduction of mobile did not reduce the number of fixed telephone access lines in use.

In those countries and areas where RTV coax systems were deployed, telecoms market liberalization around 1998 opened up another opportunity for substitution of fixed traditional telephony. [52] This became a reality through the deployment of VoIP as part of DOCSIS 1.1 from 2001. The application of a ‘best effort’ technology in a managed service environment provided for a sufficient degree of equivalence.

52 Analogue or ISDN telephony, also called PSTN/ISDN

The introduction of ADSL and the always-on access to the Internet, from early 2000 onward, enabled the more widespread use of Voice over the Internet (OTT VoIP). The first use was as a replacement of expensive international telephone calls. A much lower voice quality was offset by much lower costs and lower prices. The development of popular applications such as Skype (introduced in 2003), and the entry into the OTT VoIP field of companies such as Microsoft and Cisco supported its diffusion amongst businesses.[53]

With the introduction of 2G-GSM the opportunity for substitution of fixed telephony expanded and in many developing countries mobile services reached areas that had never seen a fixed telephone connection. In 3G-UMTS circuit switched telephony services continued to be supported, but in 4G-LTE only IP-based voice services were supported through Voice-over-LTE (VoLTE). VoLTE builds on the IP Multimedia Subsystem (IMS) and is closely linked to the Rich Communication Services (RCS) suite. RCS and VoLTE provide for telephony, message and contact management evolution. All aimed at providing enhanced end-user experience in competition with the services provide over-the-top (OTT), see Figure 2-7.[54] In this evolution the technologies used to provide telephone services have changed and the service set has expanded to include multimedia messaging. In addition, the way the call is set-up and delivered has changed, also the notion of call termination as users have multiple options to make and receive voice calls. A new phenomenon is the ‘closed user groups’ that the OTT voice services represent, as there is no roaming between the different applications.

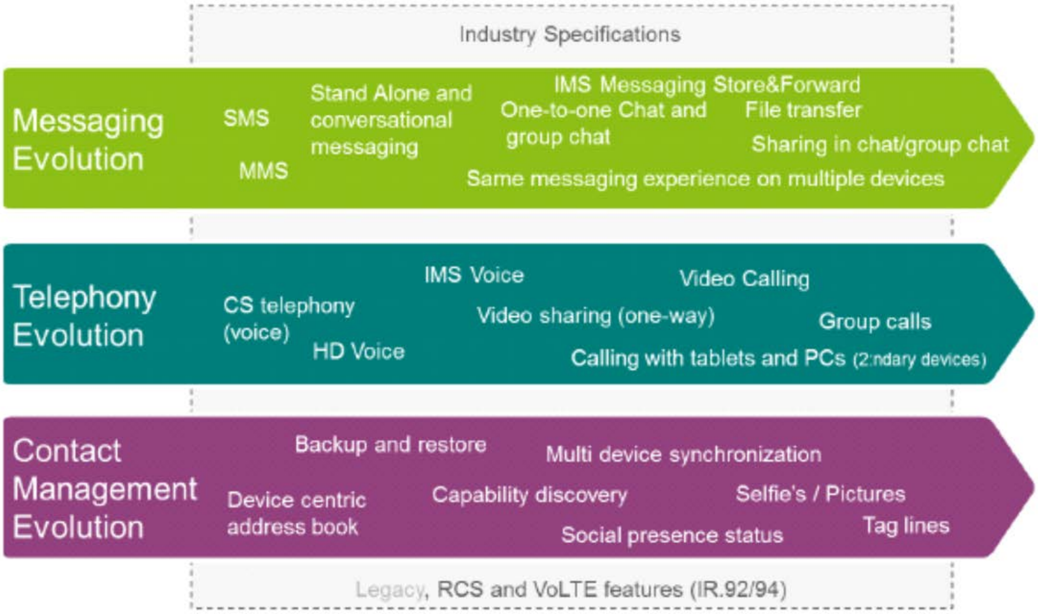
From the mid-1990s networks using Point-to-Point fibre to the home deployments (FttH) are deployed by alternative operators. In more recent years also incumbents provide FttH, but mostly on the basis of a passive optical network, which uses a Point-to-Multipoint topology. Both types of deployment provide functional equivalence with xDSL.

More generally, as the technologies used to deliver voice converge towards all-IP and the quality of the Internet improves, differences in quality and functionality are likely to reduce, supporting substitution, at least from a technical standpoint. However, other factors such as interoperability and any-to-any connectivity (including access to the emergency services) may continue to affect usage of these services by customers.

53 The access to emergency services, with the automatic identification of the caller location, is not supported by VoIP. Hence, one can debate the degree or completeness of the technical equivalence.

54 4G Americas (2014b).

Figure 2-7: Evolution of RCS and VoLTE



2.6.2 Functional equivalence of (upgraded) copper and cable network

Figure 2-8 shows existing and projected downlink data rates in Mbit/s (vertical axis) offered by twisted pair copper and coax-based cable networks over time. To allow the comparison in data rates between the shared and non-shared types of access, the typical ratio used in GPON systems is applied, i.e. 1:32 is applied to DOCSIS.[55] Table 2-1 provides the information on the performance in terms of data rates on the downlink of the two categories of access technologies and their variants.

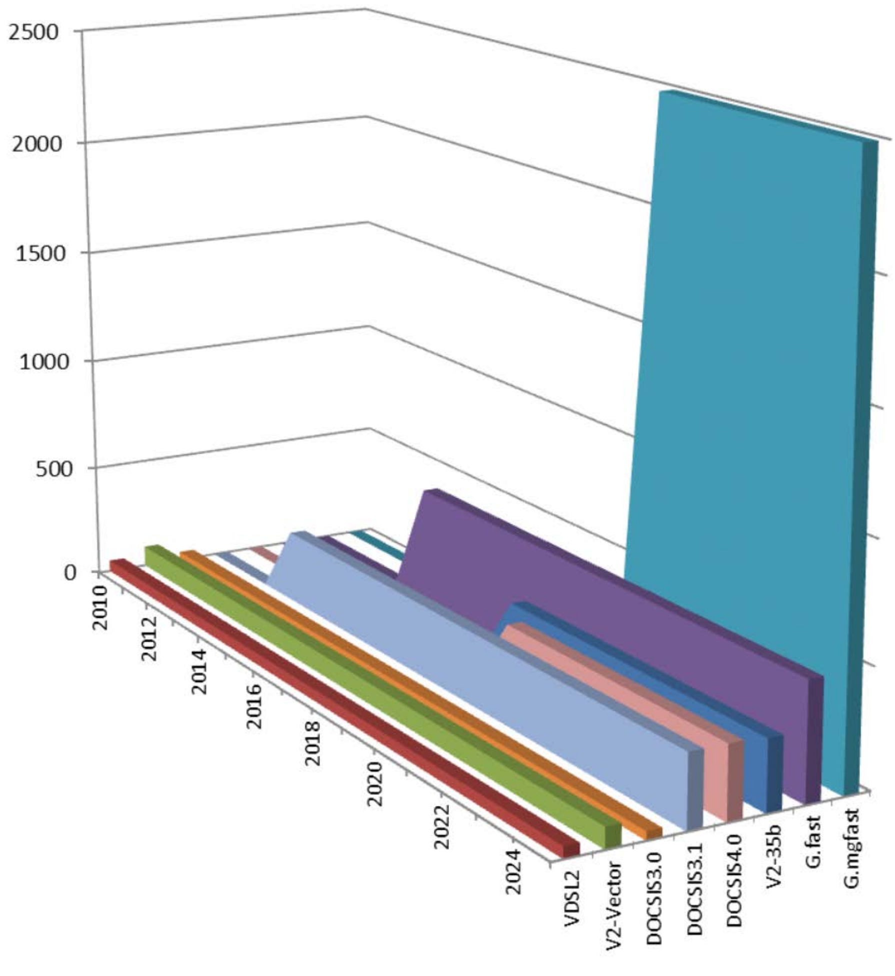
The chart suggests that in terms of downstream bandwidth, current and future generations of DOCSIS technologies provide superior performance to VDSL technologies and are likely to provide functional equivalents to G.fast networks, but may be surpassed over time by further evolutions towards G.mgfast, potentially requiring cable networks to evolve towards FttB to compete.

Looking at factors other than downstream bandwidth, it should be noted that both xDSL and DOCSISx were aimed at the consumer market and typically provide for asymmetric services, i.e., a higher data rate on the downlink versus the uplink. This may limit the degree to which the current generations of both technologies (and especially DOCSIS) can be used for business users and applications requiring symmetric bandwidth e.g. for intensive cloud usage and video-conferencing.

55 According to Downey and Mattingly (2015) the sharing ratio for DOCSIS varies in practice from 25-100 in advanced DOCSIS architectures.

A point of difference between xDSL-based services and its successors vs DOCSISx is that DSL provides a point-to-point connection while in the case of DOCSIS the connection is shared among a group of end-users. Hence, the QoS levels are fixed through network engineering and operational set-up, but vary in practice as a result of sharing the access medium. This difference has meant that PSTN-based services and upgrades thereof were considered more suitable for business use than DOCSIS.

Figure 2-8: Comparison in terms of functional equivalence between xDSL and DOCSISx in Mbit/s, 2010-2025



Source: W. Lemstra based on Table 2-1

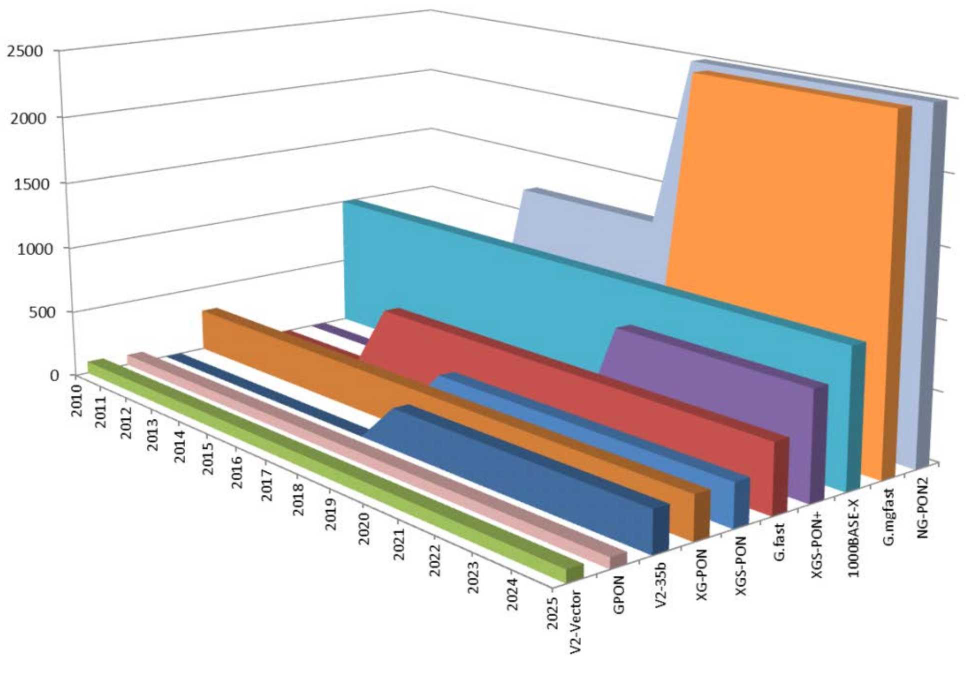
However, the more recent generations of equipment (G.fast and G.mgfast / DOCSIS 3.1 and 4.0) allow for more flexibility in setting the degree of symmetry that is provided, up to full symmetry between the downlink and uplink. Moreover, in terms of latency the two systems are converging. (See also the discussion in Annex 2 on the topic). This means that the relevance of new generations of both technologies for business purposes and high end residential needs will increase.

Meanwhile, the gap in performance and quality between earlier and newer generations of PSTN-based broadband as well as earlier and newer generations DOCSIS technologies is likely to expand, for instance in terms of symmetry. This means that over time a comparison on the basis of similar functionality is not possible anymore when comparing ADSL and FttC/VDSL and later generation upgrades.

2.6.3 Functional equivalence of (upgraded) TP copper and FttH

In Figure 2-9 the performance of (upgraded) twisted pair copper access is compared to Point-to-Multipoint PON and Point-to-Point FttH technologies in terms of downlink data rates in Mbit/s (vertical axis), reflected over time. The typical split ratio used in GPON systems is applied, i.e., 1:32. For higher capacity PON systems in practice higher split ration will apply. Table 2-1 provides the information on the performance in terms of data rates on the downlink used in this figure.[56] Note that the analysis focuses on PONs specified by ITU-T. As coax-based cable access is not present in all Member States, coax-base access is not shown in this figure – although comparisons can be derived from the previous section.

Figure 2-9: Comparison in terms of functional equivalence between xDSL, xPON and FttH in Mbit/s, 2010-2025



Source: W. Lemstra based on Table 2-1

56 Note that also a 10GBASE-X Point-to-Point FttH variant is available, however, including it in the chart would have made the comparison with other technologies difficult given its dominant size.

Based on consideration of downlink data rates, a significant gap can be seen between the capabilities of current generations of upgraded copper such as FttC/VDSL and fibre-based technologies, which may affect the degree to which these technologies are functionally equivalent from the perspective of the possible use cases by residential customers and small businesses. Upgrades of the copper network towards G.fast and G.mgfast will address this gap to some extent, but further upgrades to FttH technologies look set to eclipse the expected performance available via upgraded copper networks during the next decade. Point to Point FttH technologies already offer data rates significantly in excess of those available via upgraded copper.

As regards other parameters, both upgraded copper access and PON are aimed at the consumer market and thus typically provide for asymmetric services, i.e., a higher data rate on the downlink compared to the uplink. This may limit their relevance for users and use-cases requiring symmetric connectivity including major business users as well as business sites.

A further factor that may limit the usability of current xPON for high-end business use is that the connection is shared among a group of end-users, and thus QoS may vary.[57] Conversely, for FttC/VDSL and G.fast/G.mgfast the QoS levels are fixed through network engineering and operational set-up. In general user experienced data rates and QoS for xDSL technologies will vary based on line length and the number of active users. The negative cross-talk effects are reduced through the use of vectoring technology.

However, mass-market Point to Point FttH deployments (e.g. 1GBASE-X and 10GBASE-X) and newer generations of PON technologies (XGS-PON and NG-PON2) support symmetric bandwidths, and in terms of latency PON systems are improving towards the 1 ms range, hence, the systems are converging.[58] Thus, mass-market FttH deployments may increasingly be considered suitable for all but the most demanding business applications and backhaul.

2.6.4 Potential for substitution of fixed broadband with mobile broadband

A core question for policy-makers in the context of broadband regulation has been whether there is or may become a prospect for mobile broadband connections to provide a functional substitute for fixed broadband connections.

With the introduction of GPRS on 2G-GSM systems, the first IP-based capability was introduced in 1999. However, the data rate provided of 85/21 kbit/s was much lower than

57 For xPON on the downlink the signal is replicated to each user and hence the QoS levels are bounded by network engineering and operational set-up and vary due to the statistical multiplexing of the traffic on the downlink. As the uplink is shared the QoS will vary in practice.

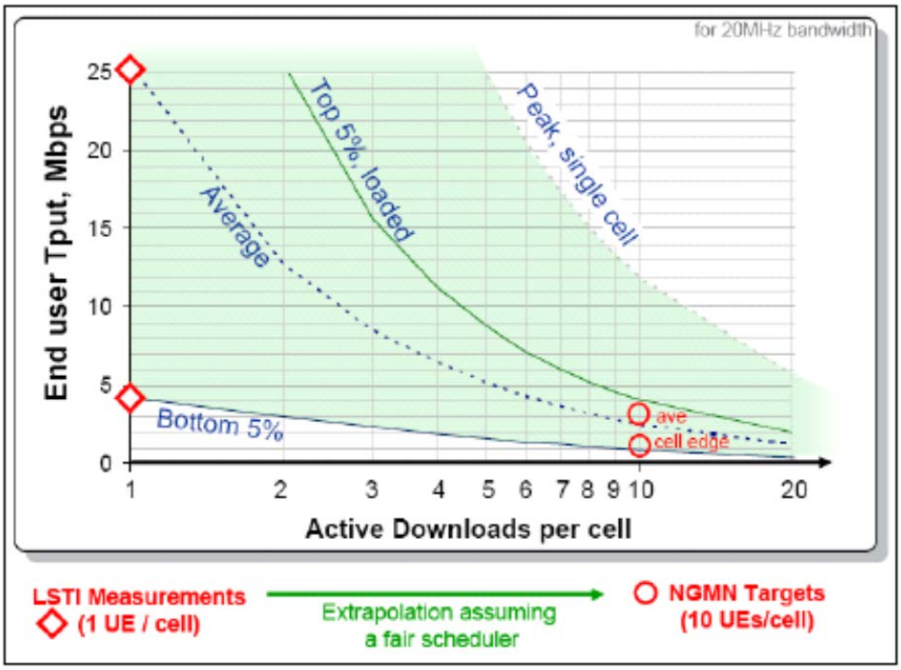
58 See the discussion on latency above in section 3.2. and Annex 2. As PtP Ethernet FttH architectures use fewer electronics in the access network, the latency of these systems is better than that of xPON architectures.

that provided on fixed lines at the time. With the introduction of EDGE in 2003 the data rates increased to 237/59 kbit/s. With the introduction of 3G-UMTS data rates up to 2/2 Mbit/s were offered. However, the fixed mobile gap persisted as ADSL was offering 8/1.3 Mbit/s, and other factors including reliability of the connection and price affected equivalence.

However, with 4G-LTE an All-IP system was introduced and a more straightforward comparison with fixed modalities can be made. Table 2-1 provides the information on the peak performance of the various types of access technologies and their evolution.

To arrive from peak to average or typical user experienced data rates is complicated due to the various design parameters involved, the actual traffic loading of the cell, the position of the user relative to the cell site, indoor/outdoor, capabilities of the end-user equipment, etc. Figure 2-10 shows the range that applies derived from a LTE/SAE trial initiative.[59] According to Motorola "the average [radio antenna] sector throughput is the measure that best represents the realistic capacity of a sector serving subscribers in a real world environment".[60]

Figure 2-10: LTE actual throughput rates based on test conditions



Source: "Latest results from the LSTI, Feb 2009" as reported in Rysavy Research (2017). UE: User Equipment (categories). See also "Mobile broadband with HSPA and LTE – capacity and cost aspects" by Nokia Siemens (2010).

59 Rysavy Research (2017). UE: User Equipment (categories). See also Nokia Siemens (2010).
60 Motorola (2009).

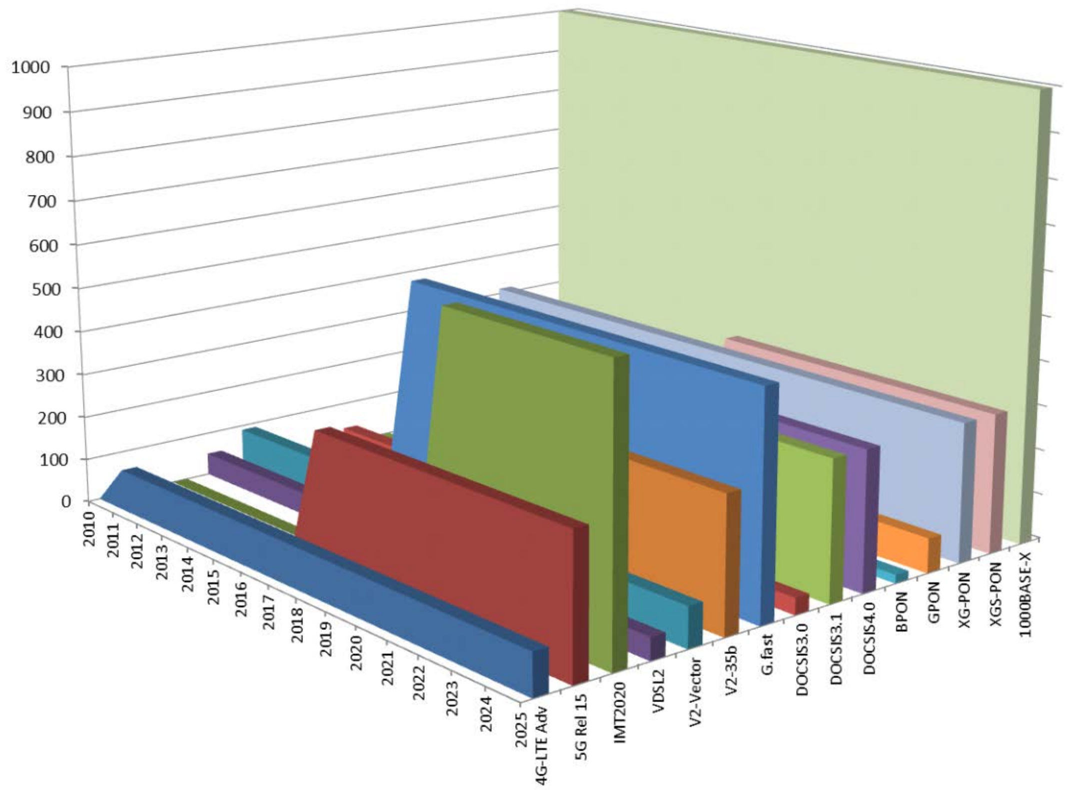
In Figure 2-11 the wireless and wireline access systems are compared on the performance of downlink data rates in Mbit/s (vertical axis) reflected over time. The chart represents the so-called user experienced data rates for 4G/5G and assumes sharing ratios of 1:32 for DOCSISx and xPON. Table 2-1 provides the information on the performance in terms of data rates on the downlink used in this figure.'[61]

The data suggests that, although significant improvements have been made in mobile downlink data rates across different generations, fixed technologies have also experienced substantial improvements and performance gaps appear to persist between fixed and mobile technologies, as upgrades in both are made in tandem. At the same time, the additional capacity that is made available is readily absorbed by the communications users as the past has shown and the continuing growth in data traffic suggests. See for the underlying data Section 3 on Market trends. Moreover, another indication that the technologies are complementary from a technological perspective is that, if the capacity in mobile networks is increased it requires additional capacity in the fixed network. In fact, to support increasing data rates the cell sizes need the shrink, which in turn extends the demand for fixed backhaul.

Differences can also be expected regarding other parameters. Although 4G/5G, DOCSISx and xPON are all technologies that share capacity across a number of users, there may be significantly more variability in the data rates achieved via mobile technologies as the number of users within each cell site varies between cells and over time. Hence, experiencing a dedicated QoS is thus likely to be less.

61 ITU definition of peak data rate: Is the maximum achievable data rate under ideal conditions (in bits/s), which is the received data bits assuming error-free conditions assignable to a single mobile station, with all assignable radio resources for the corresponding link direction are utilized (i.e., excluding radio resources that are used for physical layer synchronization, reference signal pilots, guard band and guard times). ITU definition of user experience data rate: Is the 5% point of the cumulative distribution function (CDF) of the user throughput. User throughput (during active time) is defined as the number of correctly received bits, i.e., the number of bit contained in the service data units (SDUs) delivered to Layer 3, over a certain period of time. Mohyeldin (2016). Note that the ratio between user experienced rate and peak rate increases for 5G to 200:1 from 100:1 for LTE.

Figure 2-11: Comparison in terms of functional equivalence between 4G/5G and xDSL, DOCSISx, xPON and FttH, 2010-2025



Source: W. Lemstra based on Table 2-1

Moreover, if based on substitution the substantial data volumes which are currently transmitted via the fixed broadband network were transferred to the mobile network, the additional usage would depress the average data rates significantly and require extensive further investments in cell densification, additional frequencies, and in fibre backhaul and fronthaul infrastructure.

Furthermore, there are currently significant gaps between fixed and mobile in terms of latency. Copper-based VDSL has in practice a latency of < 10 ms, although with G.fast this is targeted to be reduced to < 1ms. DOCSIS3.1 has a latency of ~100 ms at the 99th Percentile. The Low latency DOCSIS feature aims to reduce the latency to ~1ms. Through the use of dynamic bandwidth allocation techniques the latency in GPON is reduced to levels below 1 ms. Point to point Ethernet FttH architectures use fewer electronics in the access network, hence the latency of these systems is structurally better than of xPON architectures. For LTE observed latencies suggest an average of 53-63 ms against the IMT Advanced specification of 10 ms. The ITU IMT2020 specification for 5G aims at an ultra-low latency of 1 ms. Copper pairs and Point to Point FTTH will always and PON with dynamic bandwidth allocation is likely to always offer improved latency conditions compared with mobile technologies. The gaps are set to narrow with the deployment of 5G. The intensive use of fibre connectivity to the mobile antenna locations is reinforcing the converging and complementary nature of fixed and mobile technologies in a 5G environment.[62]

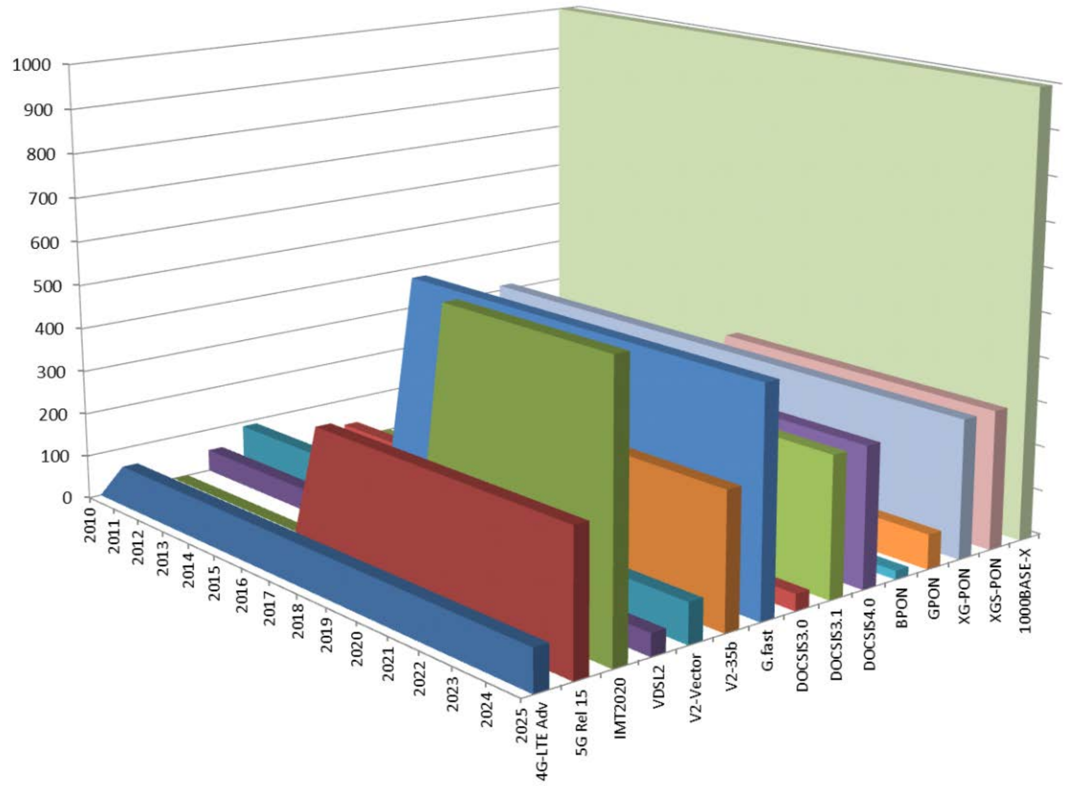
A significant difference that remains between radio-based networks and fixed networks is their sensitivity to external electromagnetic interference, such as power switching and lightning. Also snow and dense rain storms, through absorption and deflection of the signal, may distort the transmission. Even unshielded copper lines are sensitive to electromagnetic interference, while fibre links are not affected by these events at all.

2.6.5 Potential for substitution between fixed wired and fixed wireless access

A further important question concerns whether the fixed wireless access version of 4G and 5G (FWA) could offer a functional equivalent to fixed broadband infrastructure. As this concerns an engineered option, the data rates provided can be up to the peak rate of the cell/antenna sector. But engineering FWA at this rate has consequences for the cost of the service provided. If the assumption of a ratio of 1:32 peak to user rate is applied the cost effective substitution options increase. In Figure 2-12 the performance in terms of downlink data rates in Mbit/s (vertical axis) is reflected over time for this case, assuming sharing and split ratios of 1:32. Table 2-1 provides the information on the performance in terms of data rates on the downlink used in this figure.

62 See the discussion on latency in general in Section 2.2.3 and for the specific access technologies Section 8.

Figure 2-12: Comparison in terms of functional equivalence between 4G/5G at ratio 1:32 of xDSL, DOCSISx, xPON and FttH, 2010-2025



Source: W. Lemstra based on Table 2-1

The comparisons suggest that in this scenario, FWA could provide a functional alternative to fixed broadband connectivity. Specifically: FWA 4G/LTE-Advanced could offer downlink data rates which are functionally equivalent to VDSL2 and VDSL2-Vector, for DOSIS3.0 and for BPON and GPON from 2011.

FWA 5G Rel. 15 could offer downlink data rates which are functionally equivalent to VDSL2, VDSL2-Vector and VDSL2-35b, for DOCSIS 3.0 through 4.0, and for BPON, GPON, XGPON and XGS-PON from 2017.

The 5G release that will meet the IMT2020 performance requirements might present functional equivalence for VDSL2 through G.fast, DOCSIS 3.0 through 4.0, BPON through XGS-PON.

However, none of these technologies can outperform 1 Gigabit/s FttH Ethernet in a PtP topology (1000BASE-X).

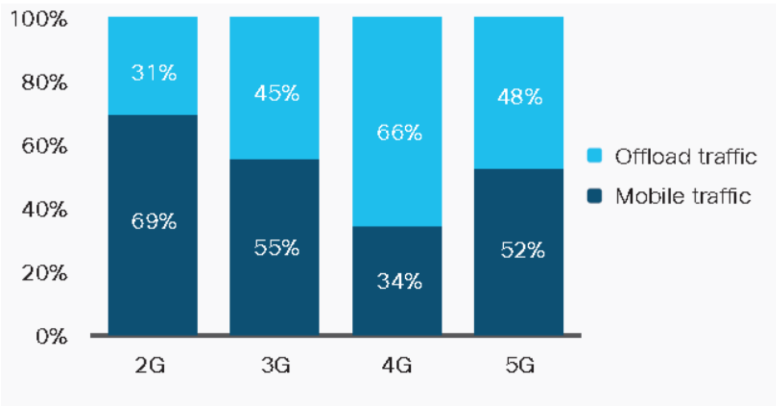
2.6.6 Substitution between licensed and unlicensed mobile broadband

For mobile systems operating in licensed bands (700 MHz through 3.5 GHz) short range wireless systems, such as Wi-Fi, operating in unlicensed bands (2.4 GHz and 5 GHz) using the wired network as backhaul, represent a functional equivalent for indoor/on premise wireless connectivity and in areas where public Wi-Fi is provisioned. In the case of License Assisted Access (LAA), the use of licensed and unlicensed access is combined to increase the data rates that can be offered, indicating complementarity rather than substitution. When QoS is considered, Wi-Fi also appears more complementary rather than a substitute for mobile broadband access, as in the unlicensed bands the QoS level cannot be guaranteed and only partially managed. Moreover, roaming between the private in-house network and the public networks is not provided; rather preference settings in smartphones typically determine the type of network selected.

In many Wi-Fi home environments the number of competing users and their interference are very limited, they also do not suffer from indoor coverage problems provided repeaters are used or a home mesh network is installed in larger premises. This is in strong contrast with indoor coverage issues of mobile networks, which strongly depends on the frequencies used – the lower the frequency, the better the indoor penetration, but typically the lower the data rate that is provided.[63]

Nonetheless, considering the scarcity of spectrum below 3 GHz, Wi-Fi offers an important offload for the mobile systems, see Figure 2-13.[64] More structural use of unlicensed bands is realized through License Assisted Access (LAA) and Authorised Shared Access (ASA) recently being standardized.[65]

Figure 2-13: Mobile offload 2G through 5G



Source: Cisco (2018).

63 Note that further isolation of homes will impact radio signal penetration negatively.
64 Cisco (2018).
65 GSMA (2013).

2.6.7 Implications of technological developments for use of mass-market and mobile connections for business connectivity

The requirements for business broadband vary widely. As long as a relatively low data rate on the uplink compared to the downlink suffices, the current xDSL and DOCSISx access systems can be positioned for business use. The need for (more) symmetrical services will require the deployment of G.fast and DOCSIS 4.0.Iin these cases the needs of SMEs can be provided by broadband offerings for the mass consumer market, provided the operators are also willing to engage in service level agreements with a high QoS. Traditionally the point-to-point copper network provided a better control over QoS than the shared coax network. Nonetheless, coax-based providers are now also targeting business users. FttH architectures also provide quality management in both point-to-point (PtP) physical or overlay architectures. The actual engineering of the network, in particular the degree to which spare capacity is built-in, determines whether higher data rate demands of business users can be provided in a timely manner in a passive optical network (PON). As the optical networks migrate to higher capacities over time, the needs of SMEs may increasingly be served through the provision of virtual circuits.

The analysis for FWA above suggests that FWA can offer data rates similar to wired solutions that may be sufficient to serve the capacity needs of some businesses. However, it remains to be seen whether the desired QoS can be provided. This is largely a matter of the technical characteristics and topologies, as well as the engineering on the one hand and costs of provisioning on the other.

As 5G allows for differentiation in QoS and allows for network slicing to provide certain service characteristics, 5G may provide a solution for certain types of business services. Moreover, it is anticipated that 5G will be able to provide to the latent needs of business users through its support of a wide range of use cases: enhanced mobile broadband; ultra-high reliability and low latency; and mass machine type communication. Furthermore, the use of 5G in enterprise networking and the flexibility it provides may offer an alternative in some cases for wired enterprise solutions. However, the high and symmetric data rates coupled with high quality requirements, security and resilience suggest that large business premises will continue to require point to point fixed connectivity. Moreover, fibre connections will also be required to support on premise base stations/antennas for industrial 5G applications.

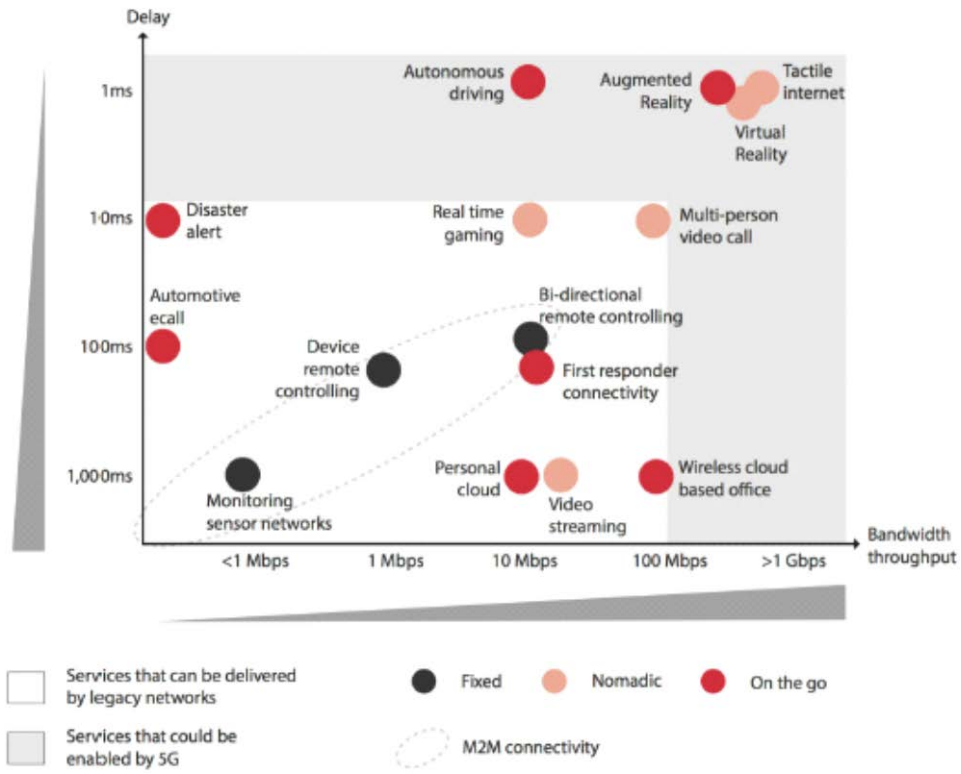
2.6.8 Communication options for IoT – mid to long range applications

To serve the emerging IoT communication needs new ‘long range – low power’ capabilities have been added to existing cellular mobile systems: EC-GSM-IoT (2G), NB-IoT (4G) and LTE-M also denoted as LTE-Machine Type Communication (4G). In the unlicensed domain

LoRaWAN provides an alternative in the mid-range, up to 5 km.[66] See Table 3-1 for the performance specifications. For IoT communication a general analysis of functional equivalence based on peak or user experienced data rates is not very meaningful as the IoT use cases vary widely across a broad range of requirements. Nevertheless, Figure 2-12 providing a view on the connectivity requirements in the Machine-to-Machine (MtoM) or IoT space in terms of data rates and latency.[67]

In practice, the selection criteria are often driven by device costs and energy use, given a certain traffic profile. Note that short-range IoT networks will require backhaul for the connection to the Internet, either through wireline or wireless means. LoRaWAN backhaul is typically provided by 4G and in deep rural areas by satellite.[68]

Figure 2-14: MtM connectivity requirements



2.6.9 Options for fixed and mobile backhaul/fronthaul

Backhaul use cases in fixed networks include the fibre connections from MDFs and ODFs in the Metro-PoP to the cabinet/distribution point in the case of VDSL, G.fast, G.mgfast and

66 Höller et al. (2014).
67 Garba (2016).
68 Private communication with T. Telkamp, LoRaWAN expert.

cabinet/amplifier in the case of DOCSISx.[69] Backhaul in mobile networks concerns the connections in the radio access network (RAN).

The current practice for mobile backhaul is a mix of microwave and optical fibre. The backhaul may be fully or partly owned or leased by the MNO. It may include the use of passive (e.g. dark fibre) and active network elements. In case of dark fibre the mobile provider has a high degree of flexibility in using any communications protocols required to control the antennas' controllers – i.e. the CPRI protocol, which cannot be encapsulated in a standard Ethernet PON protocol frame.

The expectations in terms of backhaul data rates per site are reflected in Figure 2-15.[70] For microwave backhaul the industry is focusing on the 32 GHz and the E-band (78-80 GHz), with up to 2000 MHz channels providing 5-20 Gbit/s data rates.[71] These systems are complemented with systems in the traditional MW bands (low 6-13 GHz, mid 15-23 GHz, a high 26-42 GHz) for resilience. It is expected that optical fibre will be increasingly used, while microwave backhaul will remain as a technology in the so-called tail links (~1 hop to the fibre Point of Presence) and in sparse populated low traffic areas (~2.5 hops from the fibre PoP).[72]

Figure 2-15: Backhaul capacity per site for distributed RAN, 2018-2025

	2018 Low – high cap sites	2022 Low – high cap sites	Towards 2025 Low – high cap sites
Urban	150Mbps – 1Gbps	450Mbps – 10Gbps	600Mbps – 20Gbps
Suburban	100Mbps – 350Mbps	200Mbps – 2Gbps	300Mbps – 5Gbps
Rural	50Mbps – 150Mbps	75Mbps – 350Mbps	100Mbps – 600Mbps

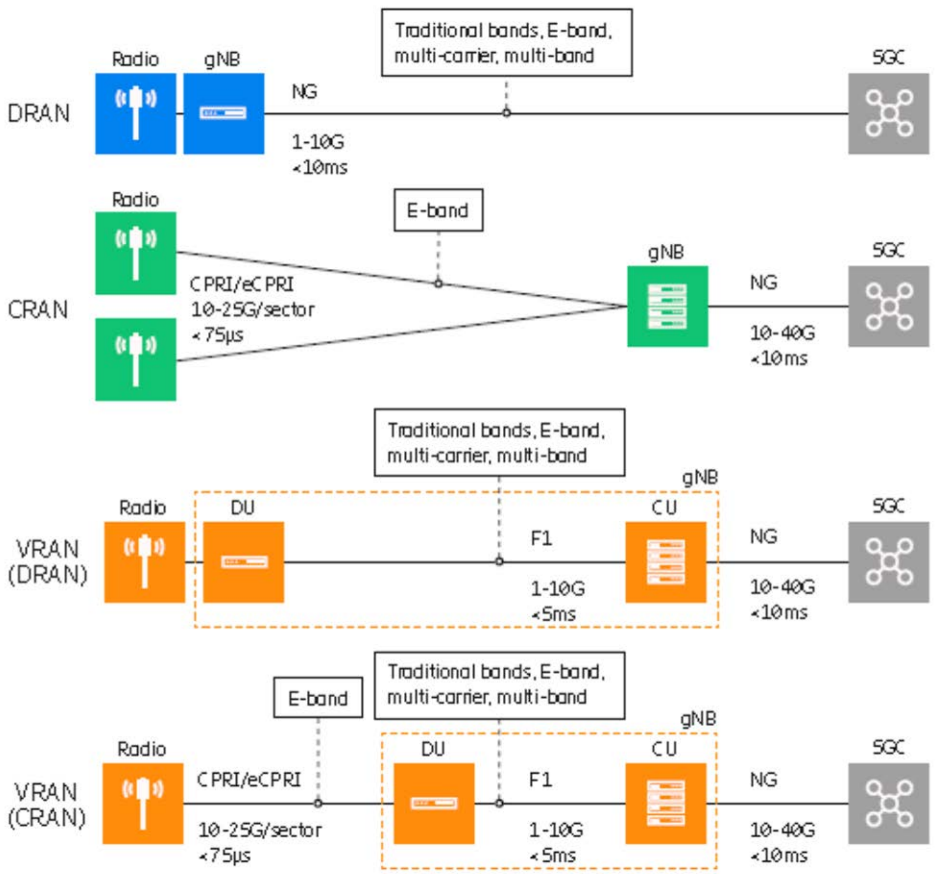
The 5G NR standard will enable a new functionality, integrated access and backhaul (IAB). Backhaul and access may be on the same or different frequency bands. The work item on this topic will be concluded as part of 3GPP Rel. 16. This capability is expected to be useful for dense mmWave small cell deployments on street-level sites. Figure 2-16 provides an overview of 5G transport dimensioning guidelines.[73]

69 MDF- Main Distribution Frame; ODF: Optical Distribution Frame; PoP: Point of Presence (formerly switching hub or local exchange).
70 This concerns eMBB networks. Ericsson (2018a).
71 Small Cell Forum (2013).
72 ETSI ISG mWT (2018).
73 Ericsson (2018a).

With the introduction of small cells the network topology for fronthaul starts to resemble the topology for FttH with a combined need for PtP and PtMP, hence, NG-PON2 and PtP fibre are positioned as a solutions.[74] WDM technology fits well with the unpredictable nature of remote placement. Moreover, the passive WDM solutions can be deployed in all outdoor environments, providing significant CAPEX and OPEX savings. A ‘colourless’ ONU provides for high degree of flexibility.

In the near future fronthaul systems are expected to support 10GbE and 25 GbE rates, rates that are supported by current day fibre-based systems.[75] This case is a typical example of access network convergence where very low latency is a key requirement.[76]

Figure 2-16: 5G transport dimensioning guidelines



Legend: gNB - 5G node B; 5GC- 5G Core; CU - Centralized unit; DU - Distributed unit; DRAN - Distributed RAN; CRAN - Centralized RAN; VRAN - Virtualized RAN.

74 Nokia (2019c).
75 In December 2018, ZTE claimed the industry’s first validation of Nx25 Gbit/s WDM-PON for 5G fronthaul in the live network of China Telecom Suzhou Branch. ZTE (2019).
76 For a discussion on the potential use of DOCSIS for mobile backhaul see the Technical Paper by -- Chapman & Andreoli-Fang (2017)

2.7 Implications of technological developments for wholesaling

2.7.1 Prospects for physical unbundling

Physical local loop unbundling (LLU) at the local exchanges (now MPoP: Metropolitan Points of Presence) was the basis of infrastructure-based competition in the last two decades. It resulted in unbundling of the copper access lines to a major share of the population in the denser populated areas of a country. In parallel, in many countries but with a lower coverage, cable-TV access network were upgraded for voice and data communication services (DOCSIS), resulting in intermodal competition. However, the deployment of VDSL2 and G.fast copper technologies have shifted the copper concentration equipment from the local exchange towards the end-customer (first to the cabinet then to the distribution point). This disabled LLU and resulted in an economically non-viable sub-loop unbundling (SLU).

Infrastructure duplication through constructing a new access network has taken place by deploying fibre access links, typically in very densely populated areas, as here the deployment cost per customer are significantly lower than in less densely populated areas. However, outside densely populated areas, there are areas where parallel fibre infrastructures to end-customers remain economically unviable, even if all copper-based customers are migrated to fibre and duct access is available. In these cases, physical unbundling is the ideal form of wholesale access for fibre networks from an economic and innovation perspective, as it does not limit the scope for product innovation by the wholesale access seekers.

In case of a PtMP topology with splitters in the field (cabinet, distribution point, …) physical unbundling at the last splitter towards the end customer is in most cases not economically feasible.[77] To avoid network architectures which are not viable for unbundling, fibres should ideally be deployed in PtP manner to be concentrated at a central office, i.e., on a higher network level than the cabinets or distribution points. Such fibre-based central offices can aggregate many more fibre links than the traditional local exchanges, where the number of access lines was restricted by the length of the copper wire to an average of 5 km. Fibre allows for 40 km and more to be bridged without repeaters. Fibre is the most future proof technology available.

2.7.2 Implications of technological developments on the implementation and capabilities of virtual and bitstream access

The development and deployment of VDSL Vectoring, G.fast and G.mgfast move the transition point from fibre to copper closer to the customer premises. As in most cases sub-

77 In France the mutualisation point in the less dense populated areas aggregates 1000 end-customer fibre PtP access lines, which may be aggregated by splitters by the wholesale access seekers.

loop unbundling is not economically feasible and as the vectoring technology used in these architectures requires all copper loops to be operated by one network operator, physical unbundling is not feasible. Hence, as typically these networks cannot be duplicated in an economically attractive manner, this development has necessitated a greater regulatory focus on virtual and active access products.

In the 2014 Recommendation on Relevant Markets, the European Commission introduced the concept of Virtual Unbundled Local Access (VULA) as a possible alternative to the use of physical unbundling in those cases where physical unbundling is not possible for technical or economic reasons. VULA should in principle allow the wholesale access seeker to the extent reasonably possible, the same degree of product definition freedom that physical unbundling provides. This demand can be broken down into the functions the EC applied to its German state aid decision on VULA[78] and which are comparable to the exiting VULA characteristics BEREC observes,[79] see Table 2-6 below. Note that such requirements go far beyond typical bitstream Layer 2 (Ethernet) characteristics.

Table 2-6: VULA requirements

Point of handover	Location of handover (e.g. cabinet, local exchange, regional level) Number of access seekers per handover point Common handover point for all VULA access technologies Common product family across all VULA access technologies
Generic access	L2 protocol Approach to contention. Obligation to increase backhaul capacity in case of contention Number of VLAN per access seeker and end-customer, VLAN tagging[80] Maximum MTU size Dedicated logical connection per end customer/availability per end user connection Customer identification for each access seeker and its customer Multicast support: Frame replication functionality

78 European Commission (2017), see also: Plückebaum and Godlovitch (2017).
79 BEREC (2015) and BEREC (2016).
80 VLAN tags are an address extension of the Layer 2 (Ethernet) protocol allowing to define sub-addresses for networks within a network (Virtual Local Area Network, VLAN). The standard allows for an outer tag (S-VLAN) and an inner tag (C-VLAN) of the same size (4094 addresses), which can be managed independently. In case of a wholesale business the outer VLAN could be managed by the access provider, and the inner by the access seeker. This allows for some product definition independence between access provider and access seeker. But both parties will have to share the address space. In case of DT's proposed use of the tags each S-tag identifies and addresses one end-customer behind a handover interface – which is dedicated to one access seeker, so it can address a limited number of end-customers per access seeker (max. 4094). There are no options that any S-tag could address a group of end-customers, as required for multicast support. The C-tags are free of use for the access seeker. These are typically used to separate data, video, IP-TV and voice traffic, and also for business customer VLANs. 4094 VLANs is a quite high number per end-customer. It also allows to transparently transmit access seeker specific and end-user specific priorities Another subdivision of the S and C address spaces could enable an increase in the number of addressable customers per access seeker or to establish additional Multicast VLAN.

Access seekers' control	CPE by ANO Bandwidth (potential for ANO control), Guaranteed bandwidth classes, symmetric bandwidth (for business) Control of service, DSL profiles by ANO, traffic prioritisation ANO determined Security: ANO able to provide security means Fault management: ANO receives actual state reports of any access line, access to diagnostic data, clear definition of faults, SLAs, KPIs and compensation over repair times, clear fault definition BSS[81] support (order interface)

VULA characteristics should be applied not only in case of FTTC/VDSL and G.fast, but also in the case of xPON based networks, unless these allow for wavelength unbundling (see below). It is already the case that DOCSIS networks are capable of providing IP-based bitstream, as defined in Market 3b.[82] With the transition to DOCSIS 3.1 FD (4.0) and the implementation of an optional feature of BSOD[83] accompanied by the full digital use of the coax cable spectrum, a VHC bitstream or VULA equivalent could also be defined for DOCSIS-based access networks. The positioning of DOCSIS-based products by operators for business use supports this assessment. In practice, the BSOD prerequisites for VULA offering are likely to be installed by DOCSIS 3.1 FD (4.0) operators, only if they are required to do so, or have sufficient spare capacity and face a competitive situation which forces them to fill their network with wholesale instead of directly contracted retail customers.

The Low Latency DOCSIS feature makes this product offering more attractive for business users.

As regards timing of DOCSIS 3.1 FD (4.0), the relevant standards have been established and systems will be available soon. However, implementing their capabilities within the networks will be a longer process, as the technologies allow for a smooth migration, network segment per network segment and even customer by customer, because the allocation of the frequency spectrum allows for parallel operation of DOCSIS releases in the same network segments. In any event, DOCSIS 3.1 FD (4.0) will require significant changes in the underlying network technologies. Fibre links will need to be deployed closer to the end customers, allowing a reduction in the size of fibre node (fibre node splitting), and the amplifiers of the end coax segment will need to be upgraded for the full bidirectional frequency range. This process will last several years. Moreover, the impetus for cable network operators to invest and upgrade will depend on the competitive situation they face, since they can upgrade their networks gradually. Liberty Global, for example noted in the

81 Business Support Systems (BSS) manage i.a. the order, change and contract termination processes and the service provisioning in an automatic manner. Operation Support Systems (OSS) are i.a. relevant for support regarding network monitoring and failure analysis and repair. For the active elements in the access seeker's value chain an interaction between the systems and processes of the wholesale partners should replace the complete internal process structure of the access seeker in a passive LLU access scenario.

82 Kroon et al. (2017) and Plückebaum et al. (2019).

83 Business Service over DOCSIS: allows for transporting L2 Services with dedicated capacity and QoS and thus enables VULA like services if sufficient upstream capacity can be provided.

context of interviews for this study, that a DOCSIS 4.0 upgrade is unlikely within the next 5 years, given that upgrades to DOCSIS 3.1 are still in the process of being completed, and may occur towards the end of a 10 year period.

Another development that may enhance the potential for service providers to innovate on the basis of wholesale access is the emergence of SDN and NFV which facilitate the so-called slicing of networks, i.e., the creation of virtual networks that can be tuned towards the needs of particular user groups or to particular users, such as MVNOs in case of mobile networks or FVNOs in the case of virtualized fixed networks.

Through virtualization, the degree of network control by MVNOs/ FVNOs can in principle be made the same as that by the MNOs/FNOs. This would remove any differences that exist today between operators that make use of bitstream or VULA access and the services that are provided by the incumbent operator. However, this requires that services management via APIs is opened up to the virtual network operators in a multi-tenant manner.

The open question is whether this will allow access seekers to go beyond or differ from the access products the access provider offers. This will depend on the suppliers' capability in offering multi-tenant OSS and network operating systems and the demand from and willingness of access providers/ incumbents to procure such solutions. SDN/ NFV based network systems are already implemented in some networks, and thus are in the process of penetrating the network platforms of the operators. However, since the features required to provide VULA-based services are not mandatory elements of the SDN/NFV implementation, a regulatory obligation to provide VULA features and characteristics would still be required to ensure that this solution is taken up. If these characteristics can be met, the point of handover for the VULA services can be migrated from local to a more regional level, following the trend of longer access network links associated with fibre transmission conditions.[84]

However, the use of network slices and virtual access on fixed and mobile networks still implies reliance on the active equipment as well as the physical infrastructure installed by the host. Thus, innovation at the level of the active network equipment typically cannot go beyond the options the host can provide for itself. This is different in the case of physical unbundling, where the access seeker has full technical and operational freedom to design its access services based on the underlying infrastructure, once the line is provisioned by the host.

2.7.3 Implications of technological developments on the potential for unbundling

The introduction of wavelength division multiplexing (WDM) in optical access networks provides an opportunity to assign different wavelengths to different operators, i.e. it allows for a functional equivalent unbundling of the access on the basis of wavelengths. However, it is the network operator that provides for the (active) WDM equipment and the provisioning of

84 Best Practice examples from The Netherlands, Denmark and U.K. demonstrate the large acceptance of VULA at regional handover compared to local handover, see Plückebaum and Godlovitch (2017).

the wavelength services. This is different from physical unbundling of the optical fibre, whereby the access seeker obtains access to the full fibre capacity (dark fibre). Thus, this solution still presents some limitations, i.e. the wavelength capacity, on the degree of innovation possible in comparison with physical unbundling (i.e. full fibre capacity, the full wavelength spectrum).

Using WDM on a point-to-multipoint fibre plant enables additional operators to use an xPON[85] technology as a shared medium access. Thus, it restricts their capability for differentiation in line with the restrictions associated with an xPON system. Moreover, an access seeker would need to purchase WDM based wholesale access at least for a whole shared fibre access string (splitter string) in quantities of 32 or even 64 end customers, even if the operator contracts only one of these customers.[86] NG-PON2 technology, incorporating up to 4 wavelengths per transmission direction could enable the incorporation and integration of WDM into one system and allows the overall capacity to be bundled, but it is not yet widely deployed, since operators do not yet see demand for this capacity, and may fear the threat of being obliged to unbundle the wavelengths.

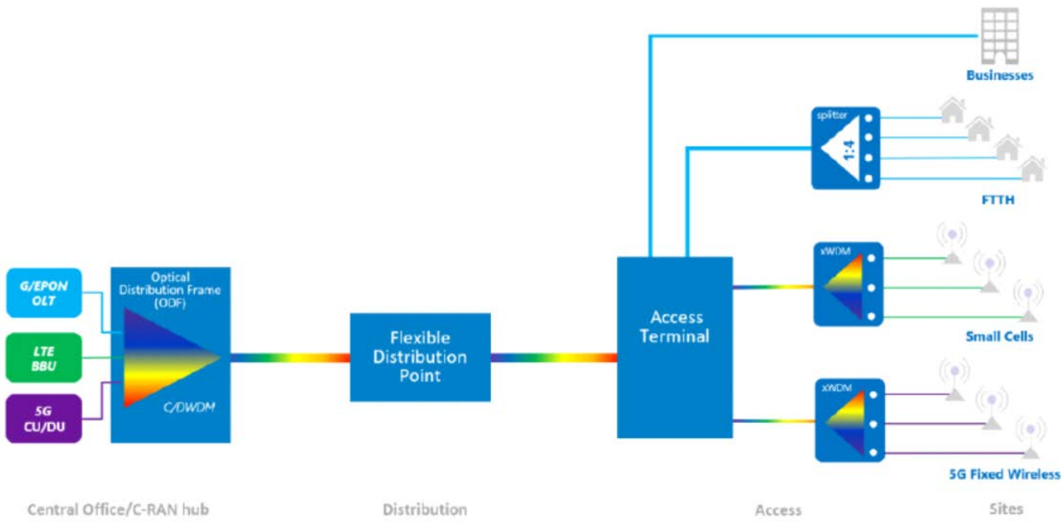
More generally, we observe that wholesale solutions based on wavelength unbundling have not been offered in the market by any operator on a voluntary basis, since for the access provider, they risk cannibalising their FTTH infrastructure and competing with their bitstream wholesale offers. The cost of such solutions has also been raised as a challenge by access providers. However, the cost of providing WDM over GPON should in principle be less than that associated with deploying additional fibre infrastructure,[87] and yet operators have in certain areas, deployed fibres in parallel rather than sharing infrastructure, and some wholesale only operators such as Stokab routinely deploy multiple point to point fibres per premises.

Using WDM on a point-to-point fibre plant would allow several operators to access the same end customer in parallel, limiting the access line capacity to the wavelength capacity of the WDM system. Such unbundling is not required, since infrastructure competition in this case could also be realized through fibre LLU.

The use of TWDM-PON provides for a point-to-point overlay over the point-to-multipoint PON. Such systems are not yet available in the market, but may be introduced within the next three years. The overlay can be made available to access seekers. Depending on the number of potential customers that can be aggregated through a single system, a backhaul service may be required to make the solution attractive from an economic perspective. See also Figure 2-17.[88] The implementation of such systems could be delayed for the same reasons as highlighted for NG-PON2 above.

85 x stands for GPON, XG-PON, XGS-PON, NG-PON (only using part of the wavelength for one operator).
86 A wholesale access seeker buying WDM PON access always occupies a complete wavelength which is dedicated to him, thus even if he has only one customer connected the other connection options in this splitter string (i.e. up to 63), it cannot be used by other operators.
87 It involves installing WDM splitters at the OLT side and dedicated receivers in the customer's ONU.
88 FTTH Council Europe (2019a).

Figure 2-17: WDM approach applied to the access network



2.8 Interconnection for IoT

In the case of IoT, devices are served directly by cellular technologies, and the mobile network provides implicitly for the backhaul and the interconnection to the Internet/application servers, which may be located on the same campus in case of local IoT networks. For alternative technologies such as Lo-Ra, interconnection to the Internet is provided by connecting the network server to the Internet. These interconnections may be wireless, cellular or fixed and they may be provided through private networks and through public networks.[89] The aggregated traffic will determine the data rates in the backhaul. The applications to be supported will determine the degree of symmetry and the latency requirements. This in turn will determine which (alternative) access technologies can be used for backhaul. See also Figure 2-14, which reflects the needs of a wide range of MtoM application in terms of data rates and latency.

2.9 Key messages from the analysis of functional equivalence in access markets

Analysis[90] of household behaviour and upcoming digital use cases suggests that consumers will increasingly require very high capacity connections of up to 1Gbit/s and more in the coming 5-10 years, in order to make use of improved video standards alongside cloud services, and applications based on virtual and alternative reality. Increased symmetry and low latency will also be required for some of these applications.

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89 LoRaWAN (2020).
90 See discussion in section 2.5.2

In addition to high and symmetrical guaranteed data rates, low latency, redundancy and high service levels are also vital for high-end business needs such as big data processing as well as for backhaul.

The Internet-of-Things introduces a wide variety of new end-users, with a wide range of communication needs, both in terms of consumer IoT and industrial IoT. These new classes of end-users typically require a different treatment compared to that we are used to in terms of consumers or business users, and may require dedicated high capacity connectivity to be available in locations where it was not previously developed (e.g. along roads, to remote businesses and farms (for digital applications).

Technological developments will allow for the provision of 1^+ Gbit/s on short inhouse twisted pair copper loops and coax systems in the near future. G.mgfast modems and DOCSIS 4.0 modems will also allow for full symmetrical connectivity and reduce latency. Through extending the fibre link much closer to the customer premises, the final metres of the legacy twisted copper pair can be made fit to serve the *top-level demand* and the CATV network for *medium level demand of residential users and SMEs*, towards the 2025 horizon. However, full fibre will be needed to provide for the *top level (plus) demand* anticipated in 2025 with full coverage desirable to meet end-user and digitisation needs towards the 2030 horizon. Full fibre also has the lowest level carbon footprint available for the foreseeable future.[91] The combined need of fibre for fixed and mobile services is expected to improve the business case for the deployment of fibre in the access network. Today, fibre in the access network is mostly deployed through a point to point or point to multi-point architecture, in which a portion of the network is shared amongst users. The introduction of TDWDM-PON systems combines the attractiveness of point to multipoint PON in serving residential users with providing dedicated high data rate and high-quality services to businesses or high demanding residential users. Moreover, these systems can provide for backhaul and fronthaul in radio access networks. However, deployment of fibre in point-to-point topologies provides an even more future proof solution, supporting consumers and businesses with a wide range of bandwidth profiles in response to demand, supporting 4/5G front- and backhauling and flexible individual bandwidth demand, up to Terabit connectivity for accessing high performance computing and large data centres.

As fibre is increasingly deployed towards the end-customer, we expect that the constraints on VHC technologies provided by ADSL and, over time VDSL, will diminish, as the capability gap widens and legacy technologies are no longer able to support the bandwidth and quality demands of a typical household or small business going forward.

Fixed wireless access (FWA) based on 4G/5G provides an alternative for fixed access in rural but also urban areas, with data rates up to 1 Gbit/s. 5G QoS management allows capacity to be assigned to specific users, provided on the shared radio medium. The economics of FWA should be considered in terms of time-to-service and in the ease of provisioning, i.e., without the need for expensive trenching. Hence, FWA is especially

91 A summary of available literature is shown in the WIK (2017b). See also Aleksix and Lovric (2010).

attractive in sparse populated areas with low traffic density and a high trench length per home connected. However, in general, wireless transmission is less performant than equal generation fixed network transmission with regards to capacity, delay and reliability/ electromagnetic robustness, and FWA may not be competitive in areas where FTTH has been deployed. At the wholesale level, physical unbundling of fibre in a fibre point-to-point FTTH network remains the best and most future proof option, enabling competitors full scope to innovate and differentiate over the infrastructure and permit deployment of all potential speeds and quality levels. VULA solutions present a compromise and provide less freedom in innovation and service differentiation for wholesale access seekers.

Although current generations of TV-cable technology do not permit the provision of wholesale access with VULA-level specifications, the deployment of DOCSIS 4.0 is likely to offer this potential, if implemented with the appropriate non-mandatory QoS options. DOCSIS 4.0 standards exist, but its deployment is likely to require significant investment and roll-out may take time, and depend on the degree of competitive threat.

In future, virtualization, through Software Defined Networking (SDN) and Network Function Virtualization (NFV), enables network slicing which allows services to be better tailored towards the needs of business users, including industry verticals, or different residential user groups, in particular in mobile networks, but also in fixed networks also, as indicated by currently implemented VPNs. These technologies allow for service differentiation, not only in the retail market but also in wholesale access. Specifically, the introduction of SDN and NFV is associated with the introduction of application programming interfaces (APIs). These APIs enable flexibility in configuring end-user services. If they provide multi-tenancy features for access to APIs of the wholesale operator’s OSS and BSS it could support the development of service-level competition, enabling VULA-capable services to be provided at a regional connection level. However, wholesale access based on SDN/NFV does not provide the scope for alternative operators to invest and compete in active equipment, and thus provides less scope for innovation than physical unbundling. Moreover, the functionality permitting the provision of flexible wholesale access is not a mandatory feature of SDN/NFV systems – and VULA obligations would likely be required to ensure its installation by SMP operators. Providing full VULA functionality at a regional (rather than local) level would also require absence of overbooking in the segment between the local and regional access point (comparable to a transparent leased line to a central location), significantly raising costs.

NG-PON2 technology, incorporating up to 4 wavelengths per transmission direction could enable unbundling of wavelengths, supporting a greater degree of flexibility for access seekers than is currently possible via VULA. However, this technology has not yet widely been deployed, since operators do not yet see demand for this capacity, and may fear the threat of being obliged to unbundle the wavelengths. Since each of these wavelengths is used as a shared medium, many of the disadvantages of shared access remain in this technology, but the intra-operator QoS interference between access seekers and between access seekers and the wholesale provider diminishes.

3 Market developments

Since the last Recommendation on Relevant Markets was adopted in 2014, significant new technologies and services have entered the mainstream and new players have entered the market while others have adapted their business models. This period has also seen new models of co-operation and a shift in some cases towards commercially negotiated wholesale agreements as an alternative to regulated access. These developments have led to changes in competitive dynamics and in the structure of some telecom markets.

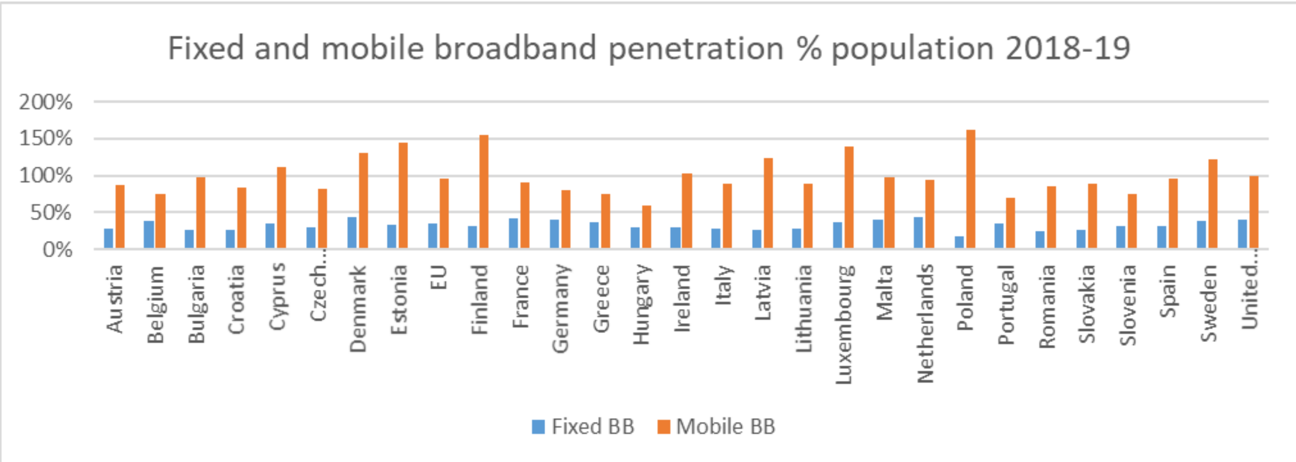
In this section, we consider first developments in communications services, and then discuss the underlying shift in infrastructure deployments and business models.

3.1 Trends in services

3.1.1 Personal communications

Take-up of fixed and mobile broadband has continued to increase in the European Union since 2014, but growth has slowed in recent years as the technologies reach saturation. There were 96 mobile and 35 fixed broadband connections per hundred population across the EU in 2019.

Figure 3-1: Fixed and mobile broadband penetration % population (2018 fixed, 2019 mobile)

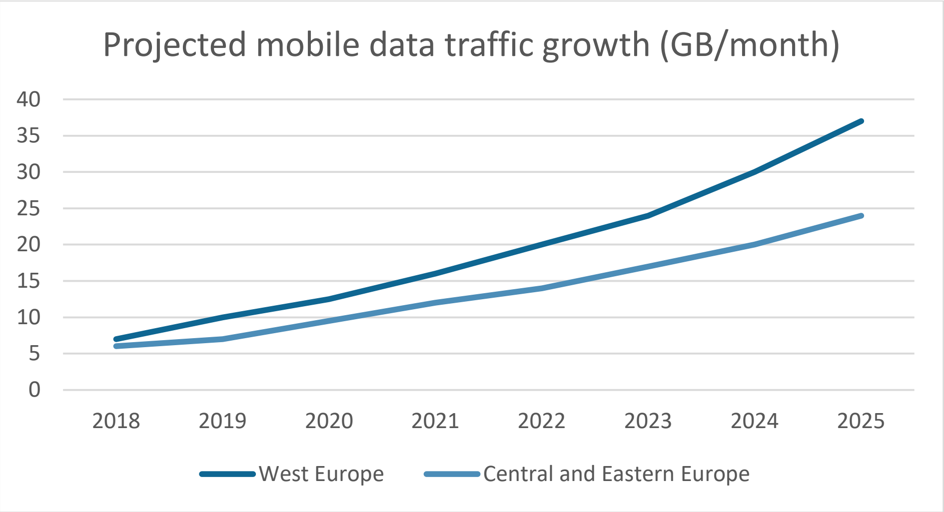


Source: European Commission

While take-up has stabilised, data usage is continuing to grow at a significant pace. For example, Cisco predicts that mobile data traffic will increase nearly five-fold in selected

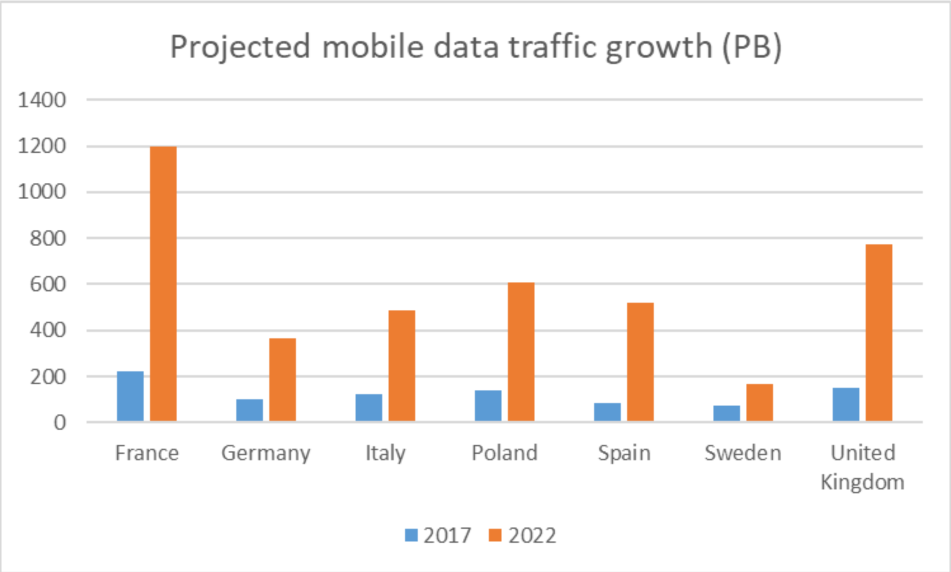
European countries between 2017-2022. Ericsson predicts[92] a 2.6 fold increase in mobile data traffic per smartphone (GB per month) in Europe between 2019 and 2025, with differences persisting in GB per month used between Western Europe (WE) and Central and Eastern Europe (CEE). In WE, Ericsson predicts GB per month to increase from 10GB in 2019 to 37GB in 2025, while in CEE, GB per month will increase from 7GB in 2019 to 24GB in 2025, triggered by the continuous increase in video consumption[93] over mobile data (through streaming and VoD services and embedded video).

Figure 3-2: Growth in data mobile consumption in Europe (GB/month)



Source: Ericsson, Mobile data traffic outlook, 2019

Figure 3-3: Projected mobile data traffic growth (PB)



Source: Cisco VNI

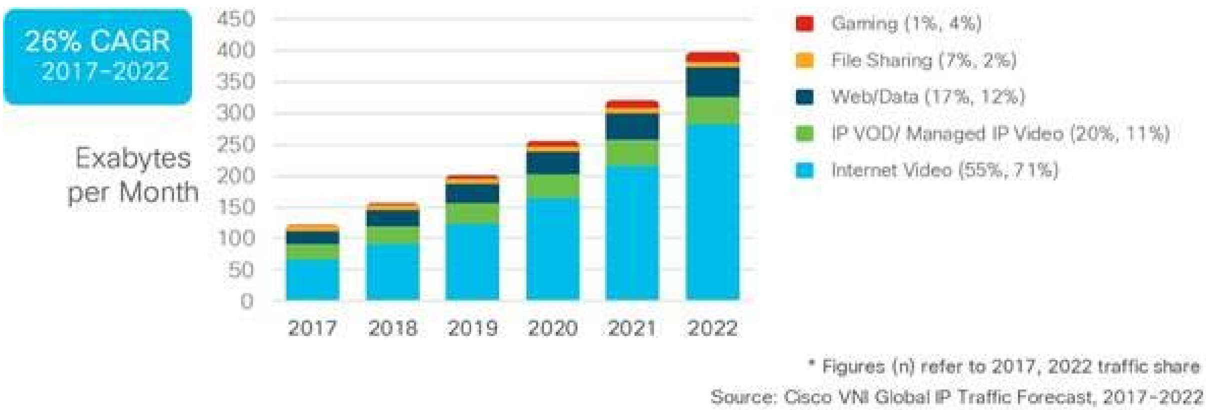
92 https://www.ericsson.com/en/mobility-report/reports/november-2019/mobile-data-traffic-outlook
93 https://www.ericsson.com/en/mobility-report/reports/november-2019/mobile-traffic-by-application-category

Demand for data has been stimulated by the proliferation of additional connected devices in the home,[94] the increasing number of MNOs offering unlimited mobile data plans[95] and in the context of IOT, as well as through increase usage of bandwidth-intensive services such as online video.

Cisco forecasts show Internet video dominating personal Internet traffic in the period to 2022. In connection with this trend, Cisco and other analysts foresee a gradual migration away from broadcast and "managed" television towards online viewing, so-called "cord-cutting".

For example, According to We are social and Hootsuite estimates[96], 92% of global Internet users watch videos online each month and 58% stream TV content via the Internet. At a global scale, Internet users spend 6:42 hours per day on the Internet, of which 2:16 are dedicated to social media. On the other hand, the average live linear TV viewing time in Europe has already dropped by 8 minutes between 2014 and 2017 to 3:49 according to Eurodata TV Worldwide, and the fall may accelerate in the coming years. IDATE also projects a gradual decline in pay-TV revenue from 2018 onwards.

Figure 3-4: Which applications are consuming the most bandwidth?



Source: Cisco VNI

In the home of the future, in addition to new generations of television screens, including 8K, connected video may also play a greater role in communications, and security. Virtual reality gaming devices are likely to be another device that places high demands on bandwidth and latency.[97]

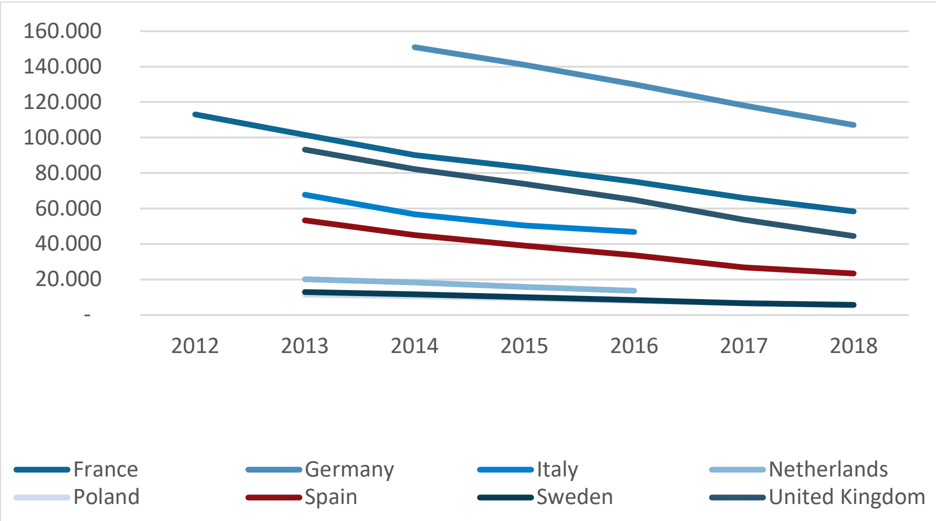
Video consumption (including user-generated content) is also likely to be a key driver for the adoption of 5G enhanced Mobile Broadband (eMBB) solutions and deployment, and the

94 Cisco predicts that the number of devices per capita will increase from 5.4 to 9.4 in Western Europe between 2017-2022.
95 Tefficient (2018).
96 Source : We are social, Hootsuite, *Digital 2019*, January 2019
97 See for instance scenarios for future household use in WIK (2018).

evolution of demand toward higher definition content (UHD) and more immersive experiences (AR/VR, video 360) will further support this trend. Additionally, social platforms favour video content development, both through on-demand and live experiences.

While data volumes and the range of applications available on both fixed and mobile networks are set to expand, traditional "managed" voice services are likely to stagnate or decline. As can be seen from the figures below, while volumes of mobile voice calls have remained relatively stable, there has been a decline in the volumes of fixed calls in many countries, and an even steeper decline in the use of SMS. ARPUs have also been in decline.[98]

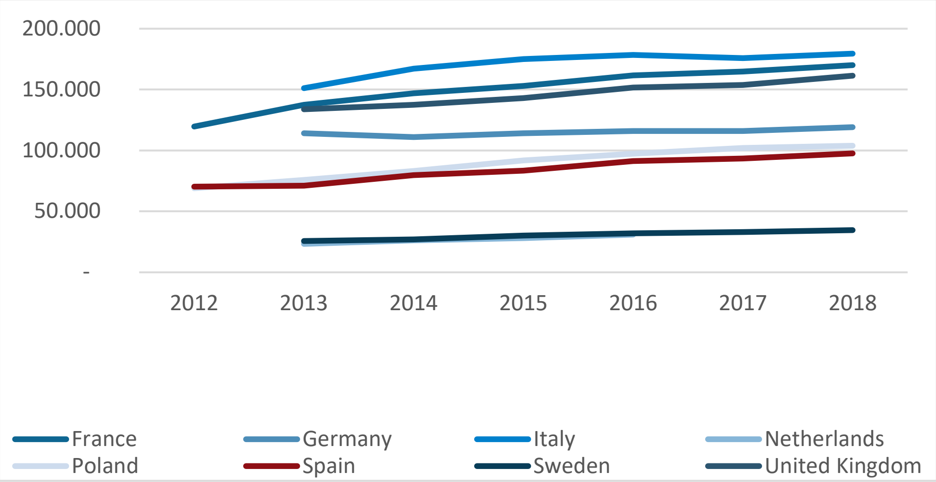
Figure 3-5: Minutes of fixed voice per country (million minutes)



Source: Ofcom, IDATE and NRAs

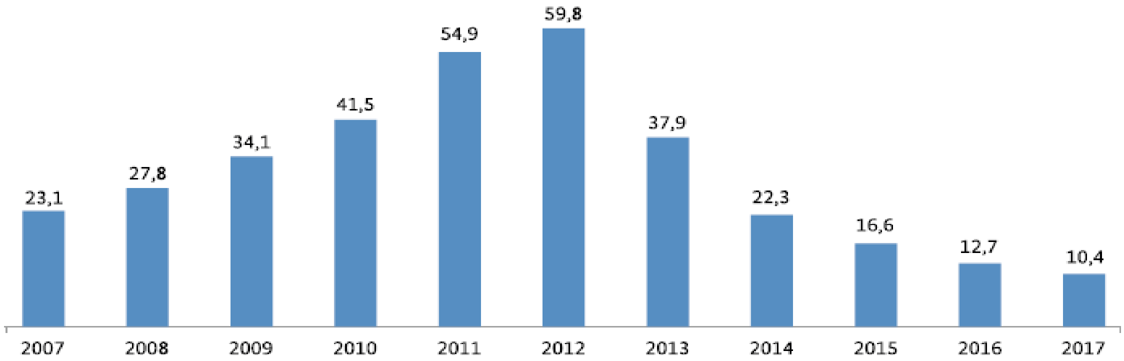
98 ARPUs from fixed telephony have been in decline, with IDATE estimating a 23% reduction between 2014 and 2018, from €16.2 to €12.4. IDATE forecasts suggest that ARPU will continue declining in the years to come, but at a lower year-on-year rate, reaching €9.4 by end 2023. By the end of 2019, the market should further decline by 10% year-on-year, to €31.3 million and continue shrinking by 20% by year-end 2023, to €25 million, due to continued reductions in ARPU and subscriptions.

Figure 3-6: Minutes of mobile voice per country (million minutes)



Source: Ofcom, IDATE and NRAs

Figure 3-7: SMS sent (bn messages; Germany)

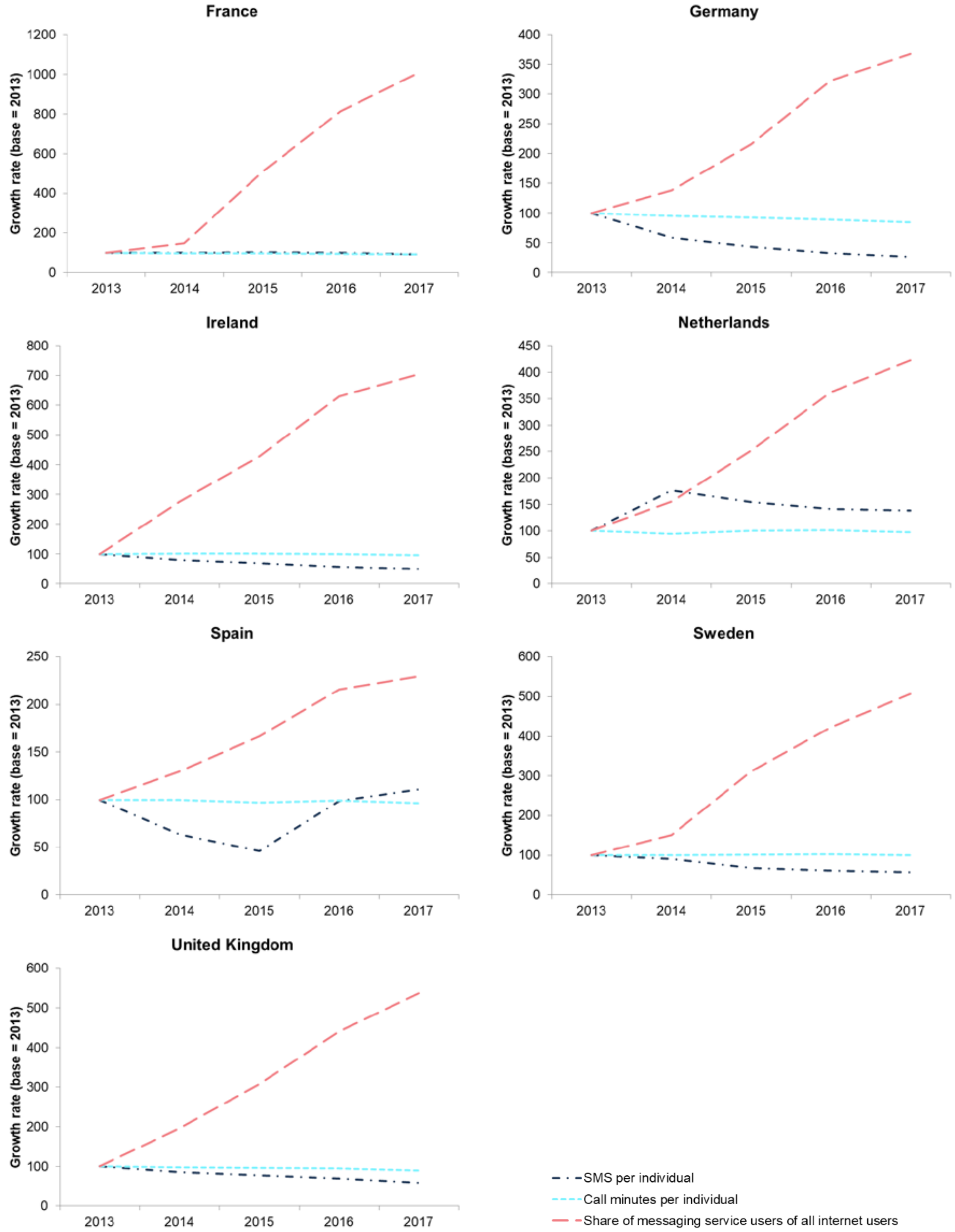


Source: BNetzA, annual report 2017

At the same time, usage of OTT voice and messaging services has been increasing. The following figure shows the change in use of traditional voice and telephony in relation to the growth in the proportion of Internet users using online messaging. Nonetheless, it is notable that the declines in managed telephony have been gradual, and managed telephony remains a core service for certain users or use cases.[99]

99 For further discussion see WIK (2019a).

Figure 3-8: Evolution of SMS, Telephony and OTT use in European countries (growth relative to the year 2013)



Source: WIK estimate based on data provided by Ofcom, NRAs, GWI and OECD. Individuals above age 15.

OTT services are also relevant when analysing competition in termination services. The common understanding thus far is that each operator has a termination monopoly on its own network. OTT services are able to some extent and for some purposes to bypass this monopoly. The extent to which this happens and the extent to which OTT and traditional services are indeed considered substitutes is thus a focus of analysis in chapter 6.

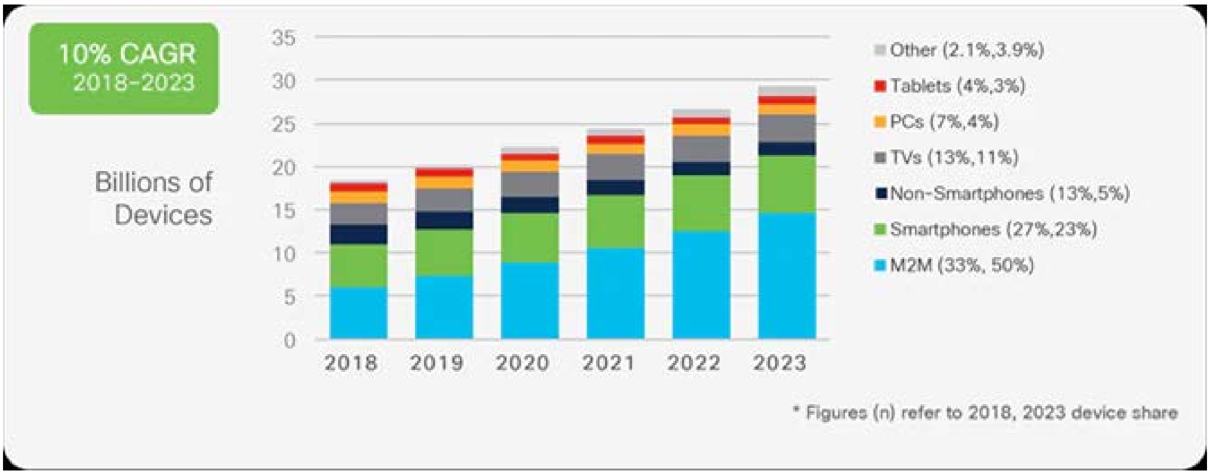
As regards future trends, towards the end of the 10 year period which is the focus of this study, it is reasonable to expect that data transmission will form the basis of the vast majority of communications services. Managed voice services will have fully migrated towards IP in most cases.[100] It is also possible that alongside growth in OTT services, we may see increased take-up of enhanced managed voice applications (Rich Communication Services (RCS)) on mobile networks, although the take-up of this service depends on various factors.[101]

3.1.2 IOT and M2M

Alongside the significant increases in data consumption for personal communications, another significant source of growth is likely to stem from M2M/IOT communications.

Cisco projects that the number of M2M devices will soon overtake the number of "personal" devices on a global basis. These M2M devices include consumer electronics, industrial equipment, lights, meters, sensors, trackers, vehicles, etc. In Western Europe, Cisco predicts that M2M modules will account for 63% of all networked devices by 2022 and will average 2.1GB in data usage per month, up from 0.8GB in 2017.[102]

Figure 3-9: Global devices and connections growth

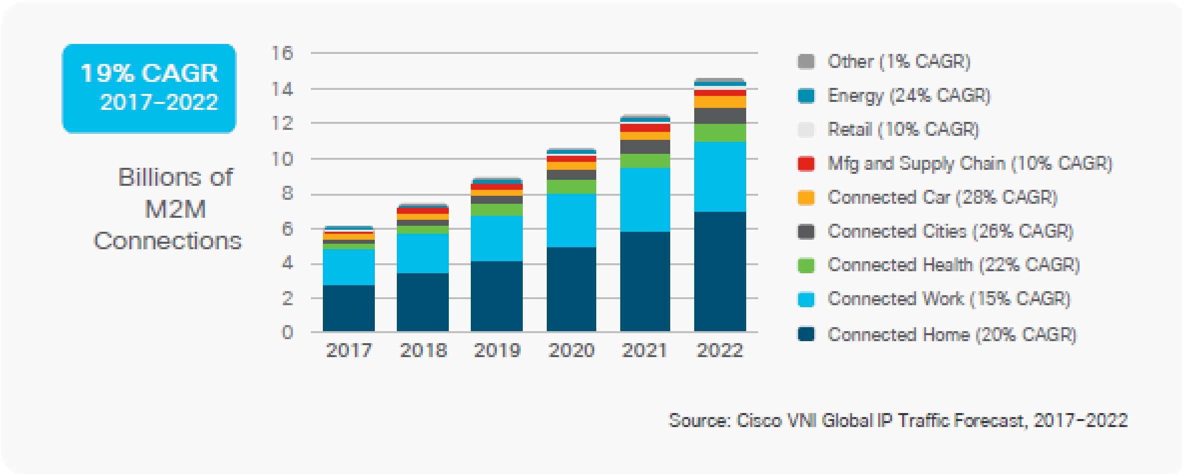


Cisco projects that connected homes and workplaces will lead in M2M-based data consumption in the years to come. However, as the following figure illustrates, significant

100 See announced plans in the benchmark conducted in WIK (2019b).
101 Factors include compatibility of devices and interconnection. For a wider discussion see WIK (2019a).
102 Cisco (2020).

roles are also expected for smart applications in the field of connected cars, cities and healthcare.

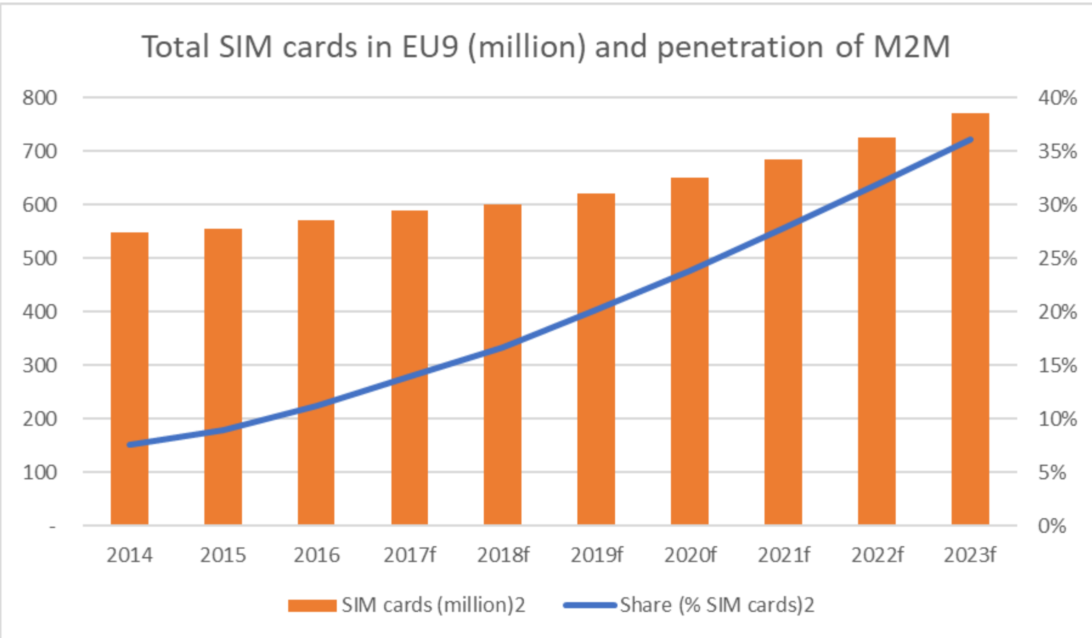
Figure 3-10: Global M2M connection growth by industry



Source: Cisco VNI

In 9 EU countries[103] tracked by IDATE, M2M cards are predicted to expand by nearly 25% year-on-year in 2019 to 125.2 million in EU9 (20.1% of EU9 SIM cards) and reach 278.8 million in 2023 (36.1% of SIM cards).

Figure 3-11: Total SIM cards in EU9 (million) and penetration of M2M



Source: IDATE, *TMP database*

103 Belgium, France, Germany, Italy, the Netherlands, Poland, Spain, Sweden and the UK.

5G represents a further opportunity for the growth of M2M cards. 5G is expected to gain traction from 2020, and IDATE forecasts that 5G will represent 8.7% of total M2M SIM cards by 2023. The automotive market and data-hungry applications are expected to support early adoption of eMBB. Massive IoT is expected to follow after 2022 when modules become available.

Table 3-1: Main vertical targets, EU5

France	Germany	Italy	Spain	UK
Media and Entertainment Automotive Transport, Industry 4.0 Construction Logistics Agriculture Smart Office	E-Health Future Media (or Media and Entertainment) Intelligent Mobility Industry4.0 Smart grids Smart Farming	Smart cities, Public safety, Environmental monitoring, Industry 4.0, Smart port, Media and VR, Transportation and road safety, Smart agriculture, Health 5.0, Tourism and cultural heritage	eHealth, Automotive, VR/AR	Automotive, Industry (factories and process automation; construction; farming and agriculture), Health, Public safety, Tourism, Transport and logistics

Source: IDATE, *5G Europe, 2019*

3.1.3 Digitisation of industry

As businesses embrace digitisation, their service demands have expanded to cater for remote networking, digitisation of industrial processes and the cloudification of services.

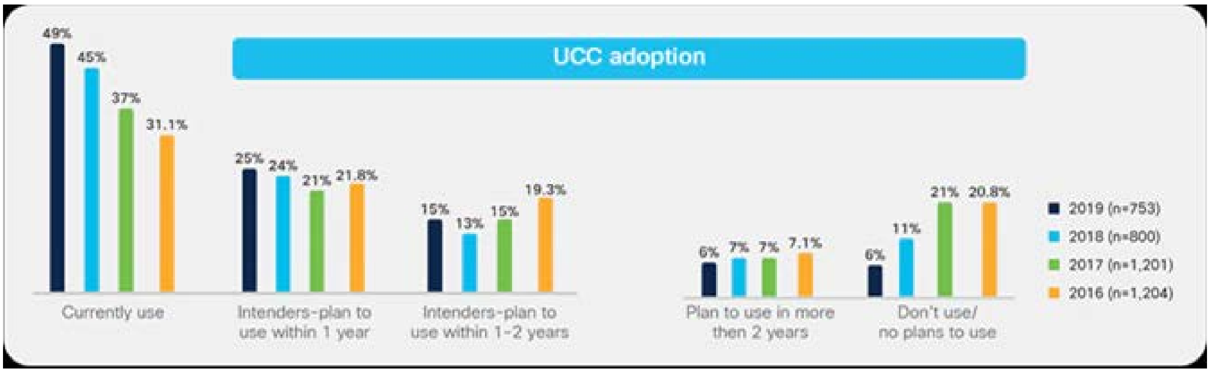
<u>Unified communications and collaboration</u>

The trend in business communication has been towards remote collaboration, through unified communication and fixed-mobile bundling. Moreover, IT services such as integrated audio, video solutions and web conferencing have been supporting the trend towards remote collaboration between teams.

According to a survey conducted by IDC, in the US (one of the more advanced countries in embracing digital communications services), nearly 75% of businesses are currently using unified communications and collaboration services or plan to do so within one year.[104]

104 Cisco (2020).

Figure 3-12: Unified Communications and Collaboration (UCC) adoption



Source: U.S. Enterprise Communications Survey, IDC, 2016, 2017, 2018, and 2019 (preliminary results)

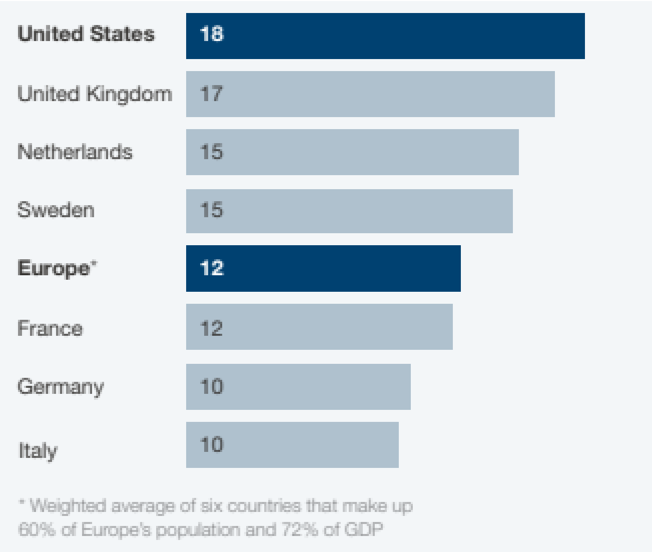
Virtualisation of the workplace is being supported through IaaS cloud offerings to tackle the virtualisation of business applications, data centres, marketplaces, networks, security and storage.

Digitalisation of industry

Another important trend has been the digitisation of industry. Digitisation of industry refers to the development and industrial use of digital applications and services such as IoT, cloud computing, big data, artificial intelligence and robotics to improve processes and business productivity. Recent studies estimate that digitisation of products and services can add more than EUR 110 billion of annual revenue to the European economy in the next five years.[105] In a 2019 EU analysis report for the European Commission on monitoring progress in national initiatives on digitising industry, VVA and WIK found that actions had been taken in all member states to support the digitisation of industry, with a particular focus on the manufacturing sector. However, a number of challenges remain and progress towards digitisation remained patchy.[106] McKinsey analysis (see below) further highlights the gap between the US and Europe in this regard.

105 European Commission (2020a).
106 European Commission (2020b).

Figure 3-13: Share of digitalisation potential realised, June 2016



Source: McKinsey Global Institute, Digital Europe: Pushing the frontier, capturing the benefits, June 2016.

Moving forward, there is a clear intensification of these two trends, especially concerning the digitisation of industry. This is likely to involve the development and integration of IoT in business structures with an attendant impact on communications needs between machine and with the cloud-based businesses.

3.1.4 Cloudification of services

Digital context delivery and sharing, alongside data storage and big data processing have been accompanied by a rapid increase in the use of cloud services and the expansion in data centres. In its annual Global Cloud Index, Cisco noted that, for consumers, streaming video, social networking, and Internet search are among the most popular cloud applications, while for business users, enterprise resource planning (ERP), collaboration, analytics, and other digital enterprise applications represent leading growth areas.

Cisco's study[107] forecasts that global cloud data centre traffic will reach 19.5 zettabytes (ZB) per year by 2021, up from 6.0 ZB per year in 2016 (3.3-fold growth or a 27 percent compound annual growth rate [CAGR] from 2016 to 2021).

In order to support these increasing demands, Cisco sees an increase in the number of large-scale public cloud data centres. In turn, the increasing reliance on the cloud is necessitating an expansion in connectivity for high performance computing centres (towards terabit connections), alongside an expansion in the connectivity requirements for the

107 Cisco (2016).

businesses that make use of them, and is likely to further drive demand for dedicated connectivity, especially in the business segment.[108]

3.2 Strategic responses by operators

Operators have responded in different ways at the retail level to the growing importance of mobile broadband and the potential threats and opportunities presented by OTT and IOT.

3.2.1 Consumer bundling

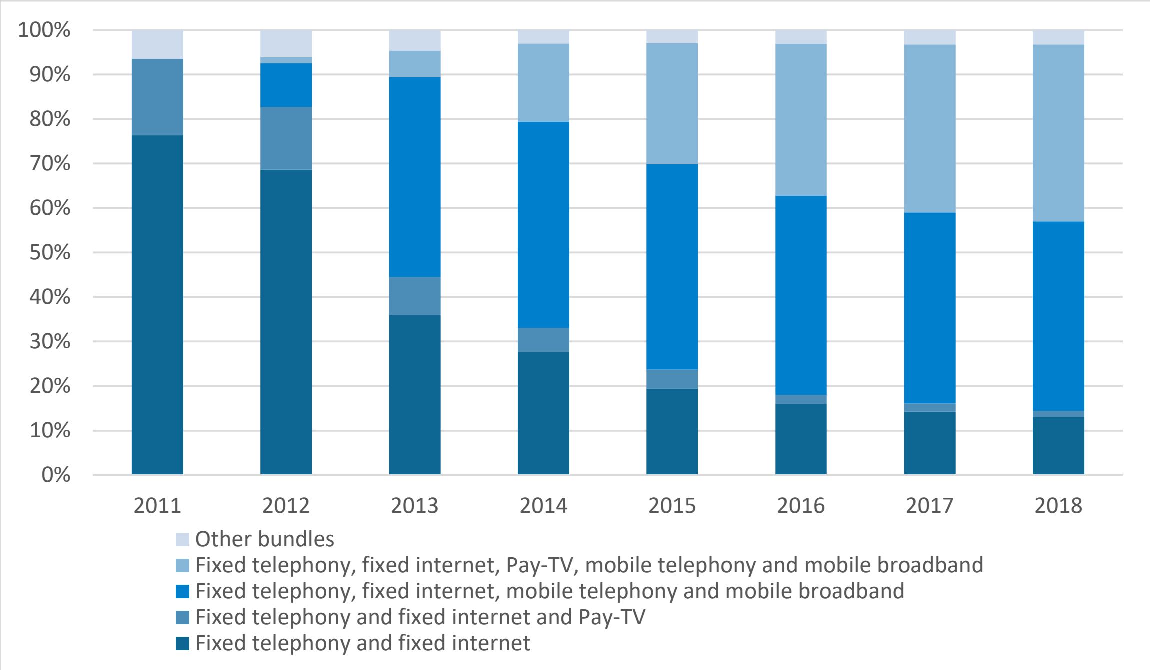
One strategy that has been pursued by telecom operators in some countries to safeguard revenues and reduce churn is bundling. Double play bundles coupling voice with broadband have been common since the introduction of ADSL broadband. In recent years, triple and quadruple play (with mobile) bundles have become more prevalent in certain countries, supported by consolidation and convergence between fixed and mobile operators (see section 3.1.5).

According to the Eurobarometer survey, almost 60% of respondents said they bought at least two communications services as a bundle. While there are differences between member states, it is interesting to note that only two countries in the survey had a bundle penetration rate of less than 50% of households.

For example, the chart below shows how fixed mobile bundles have become the most popular combination in Spain.

108 See discussion in Ecorys et al. (2020).

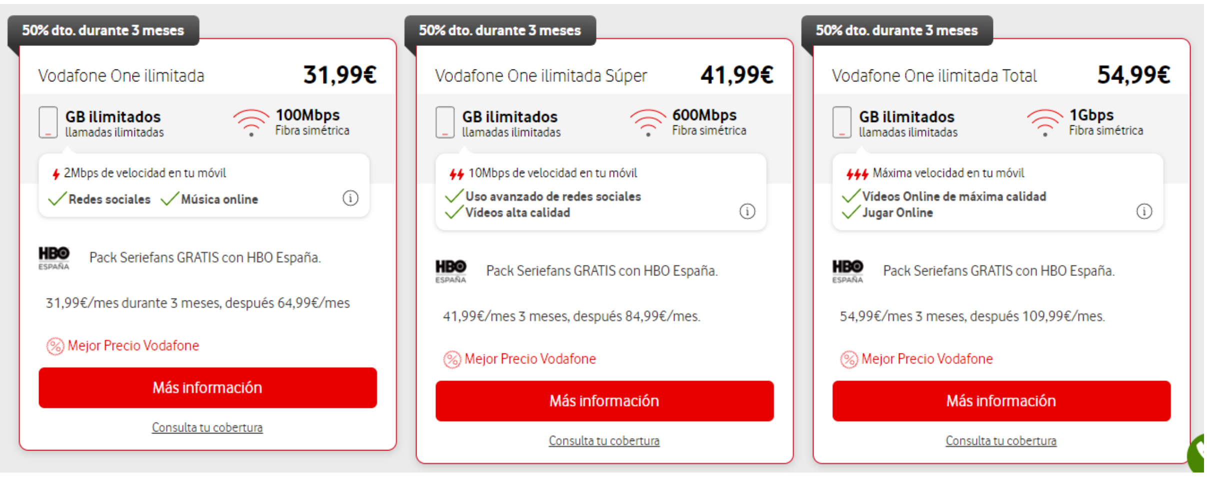
Figure 3-14: Evolution of bundles by type, example of Spain:



Source: IDATE based on CNMC data

An example of fixed-mobile packages from the Spanish market is shown below. All packages include unlimited data (including speeds of 2Mbps for social media and online music), unlimited calls (fixed and mobile), roaming in Europe and the USA, symmetrical fibre (with different speeds in each package), multi SIM service, and Secure Net service. The inclusion of a high volume or unlimited calls within fixed and mobile bundles may have helped to maintain usage of managed telephony, and stem potential bypass that may have occurred to OTT alternatives, had these bundles not been offered.

Figure 3-15: Double play (fixed internet and mobile services), Vodafone Spain:



Source: Vodafone Spain, as of 30 October 2019.

Beyond bundling traditional services such as voice to encourage usage, another development has been to bundle OTT services within the offer as a means of leveraging customers' preferences for certain applications. OTT video may be included within fixed broadband packages,[109] while messaging applications may be given favourable treatment (such as "zero rating") within mobile bundles.[110]

Some telecom operators which had invested in traditional premium pay TV, have also responded to the OTT challenge by themselves launching an OTT version of their linear services, generally at lower prices, to limit consumers' haemorrhage and decrease in revenues. According to IDATE estimates,[111] pay-TV revenue reached a high point in 2018 and will begin to decline slowly. They should lose around 1.5% by 2022.

The barriers for switching providers are likely higher for bundled customers than for subscribers of several standalone services. The lock-in effect a bundle creates may thus make it more difficult for operators to attract subscribers from their competitors. Eurobarometer finds that just under half of bundle subscribers had switched their provider at least once. Of these, 55% experienced some problem during the transition, mainly due to temporary service unavailability or the need to replace equipment.

A key question from the perspective of market definition and analysis is whether bundled markets may be identified at the retail level, and if so, whether at the wholesale level, all inputs are available or can be supplied on a competitive basis to enable competition in the bundled retail service. A further question is whether bundles may be affecting substitution between voice and OTT that could otherwise be expected to occur.

3.2.2 Business value add

As the requirements of businesses have evolved to encompass a range of IT and IOT solutions, the range of services required has expanded and the players in the value chain have evolved. Indeed, the focus of large business customers' attention has shifted to the extent that in an interview conducted for this study, the business user association Beltug observed that large corporations no longer typically "buy telecoms" and that purchasing and operational decisions are now made by IT managers rather than communications managers. They also note that "telecom" services have to a large extent become software. The combination of connectivity and applications has, according to Beltug raised a new set of competition issues as vendor lock in practices have become more prevalent.[112] Interviews with multi-national business communication providers in the context of this study also confirm that they are increasingly partnering with "systems integrators" such as Microsoft

109 TelecomTV (2018).
110 See for example Capacity (2016).
111 IDATE (2019).
112 Interview with BELTUG/INTUG Chairman November 2019

and Amazon, although some businesses continue to procure their communication services separately.[113]

As progress is made towards digitisation of industry, we can expect multi cloud integration solutions which aim to ensure flexibility and scalability for large enterprises, integrating multiple (public and private) cloud infrastructures and applications for business customers. Provision of these solutions might involve partnerships between several actors in the ICT ecosystem (software package publishers, global IT providers, telecom operators, cyber security companies, etc.). The result may be that whereas telecom operators provided the main interface for the provision of business connectivity to corporations, they may become partners, or wholesalers to specialist integrators or others higher in the value chain.

An example of the actors involved in connected automotive mobility is shown in the following chart drawn from the 2020 study for the European Commission on implementation of CEF Digital.[114]

Figure 3-16: The value chain for Connected Automotive mobility

	OEM	Road	Telco	Platform	Regulator
Commercialisation Statement	Premium segment with own CAM platform Shared Vehicles in city	For some actors: activation and responsibility of the service		Google/ Apple	
Facilitator			Active Participer *Co-devlopement*		Pilots to help actors identify needs and costs
Possible way to address consumers	At the vehicle sale Digital platform in the vehicle	Through tolls (pay per use)	Mobile plan	Through Application	
Prerequisites	Sensors Connectivity V2V, V2I, V2N	V2I Infrastructure Fibre Infrastructure	V2N Infrastructure	Integration with OEM	Area Permit

Source: IDATE

In order to support their clients' digitalisation processes, some telecom providers in the EU[115] have moved into the value added segment and have been offering different cloud solutions (SaaS, IaaS and PaaS), tailored to clients' needs. In the SaaS segment, priority has been given to catering for the growing need for digital services in businesses including virtualising the workplace and remote collaboration (virtual office and virtual collaboration), providing an alternative to the services offered by global IT providers such as Office 365 (Microsoft), G suite, LibreOffice, Open office and iWork (Apple), among others.

Business service providers are also seeking to provide solutions to large companies' need to access public and private cloud services using a combination of best-effort Internet

113 Interviews with BT Global and COLT Feb-March 2020
114 Ecorys et al. (2020).
115 For example, NOS Portugal is selling Mail Pro, Web Pro, and SMS Pro SaaS cloud solutions.

alongside more traditional dedicated connections. For example, the business model of BT Global (formerly BT Global Services) has evolved from a focus on supplying secure connectivity across multiple dispersed sites to providing virtual secure pathways to cloud-based services, some of which may be accessed via Internet connections supplied by the client itself, coupled with SD WAN technology.[116] BT Global notes that basic (mass-market) Internet with SD WAN may be appropriate especially for smaller or less critical sites or for back-up. On the other hand, demand for dedicated (point to point) high bandwidth connectivity persists for larger sites and business critical connections, an observation shared by COLT.[117]

3.2.3 Horizontal separation

While some telecom infrastructure owners have sought to diversify into retail markets (for example content in the case of consumer services, cloud and IOT in the case of business services), others have chosen to focus at the infrastructure level as "wholesale only" providers.

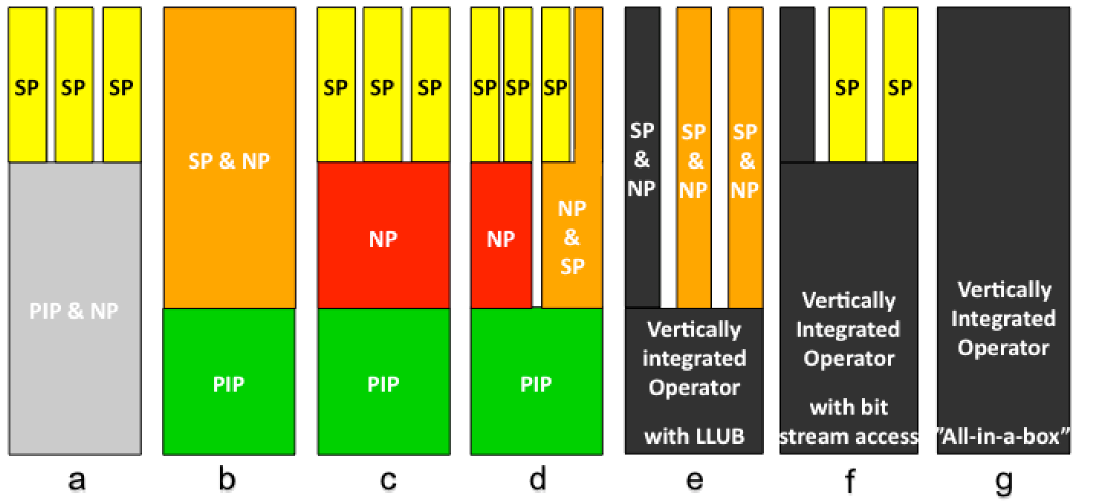
Examples of the wholesale only business model can be seen in Sweden (municipal networks), Italy (Open Fiber), Ireland (SIRO), the UK (Cityfibre) and in certain rural networks in France and Austria.[118] Entry by non-telecoms operators such as utilities or operators linked to municipalities has expanded in recent years, in many cases as a response to the failure of incumbent operators to upgrade their networks towards gigabit capabilities. As these types of operators do not have an existing retail customer base and/or (in the case of municipalities) may intrinsically prefer to avoid competing with commercial retail service providers, many have pursued a wholesale only approach.

A common feature amongst wholesale only providers is that they are not present in the retail market and do not have exclusive agreements with retail operators. However, beyond that, the business models pursued differ. For example, whereas Stokab in Sweden is present only on the physical level and offers dark fibre to a range of network and service providers (option d in the diagram below),[119] Open Fiber offers a range of wholesale services ranging from dark fibre (which is mandated under its Concession associated with the receipt of state aid), through to bitstream and resale services, enabling service providers without significant infrastructure of their own, to provide Internet services (option a). Meanwhile in Denmark,

116 Interview with BT Global February 2020.
117 Interview with COLT March 2020.
118 Structural and legal separation have also been pursued by some incumbent operators including CETIN in the Czech Republic, but as these newly separated "wholesale" operators have control over the legacy copper infrastructure, their incentives and involvement in the upgrade of networks to VHC may be different from operators which have entered the market as wholesale only operators focused on the provision of FTTH.
119 The Stokab model is further elaborated in WIK (2018b).

some fibre utilities operate only on the wholesale level (focused on the provision of bitstream), but channel all retail sales through a single platform.[120]

Figure 3-17: NGA deployment models by degree of openness



Legend: LLUB – Local Loop Unbundling; NP – Network Provider; PIP - Passive Infrastructure Provider; SP – Service Provider.

Source: Forzati & Mattsson in Lemstra & Melody (2015) The dynamics of broadband markets in Europe – Realizing the 2020 Digital Agenda." Cambridge University Press.

Although the wholesale only players which do not have connections with any retail provider are unlikely to have an incentive to discriminate between different service providers, if they offer bitstream or resale, they may have an incentive to favour the supply of this value added service at the expense of dark fibre provision which may be more conducive to competition and innovation by a range of network operators or other customers.

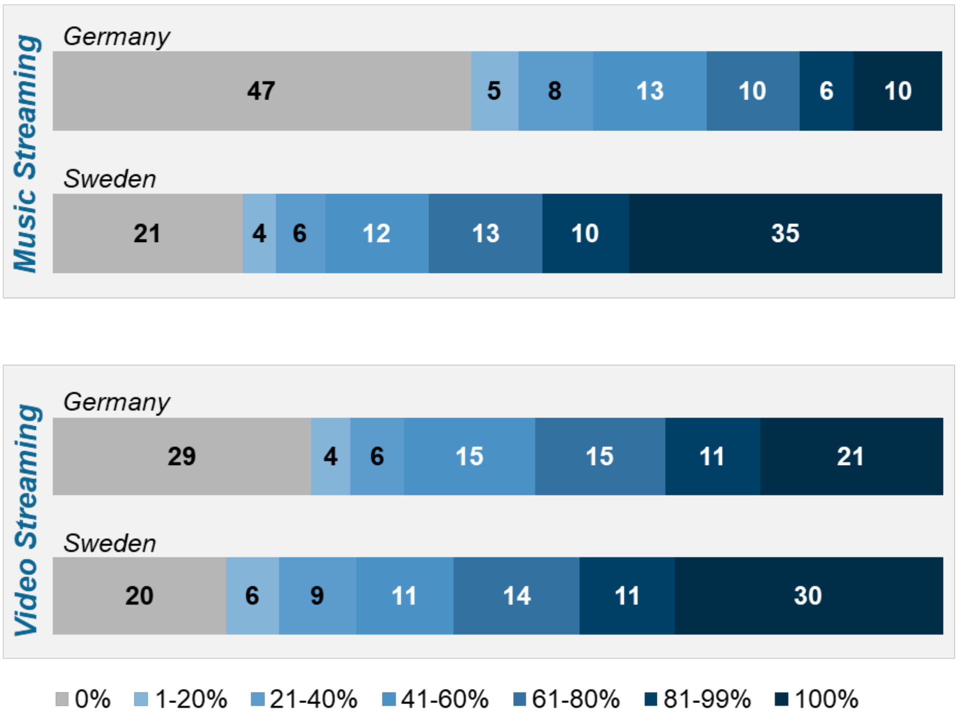
The development of retail services in areas in which passive (dark fibre) wholesale only operators are active has been driven by a range of actors, with a greater role for niche service providers, OTT players in video and communications, and the potential for IT companies, intermediaries or verticals themselves to play a greater role in the provisioning of IOT.

For example, one of the effects of the availability of wholesale only fibre networks in Sweden, seems to have been to support the availability of broadband only connections (dumb pipes), rather than bundled offers.[121] Trends towards fixed mobile convergence have also been less pronounced in Sweden, with one of the operators 3 continuing to operate as

120 See discussion in the WIK (2019c).
121 See WIK (2017c).

a standalone mobile operator. Another effect may be greater reliance on OTT, potentially instead of traditional TV, as shown in the following figure.

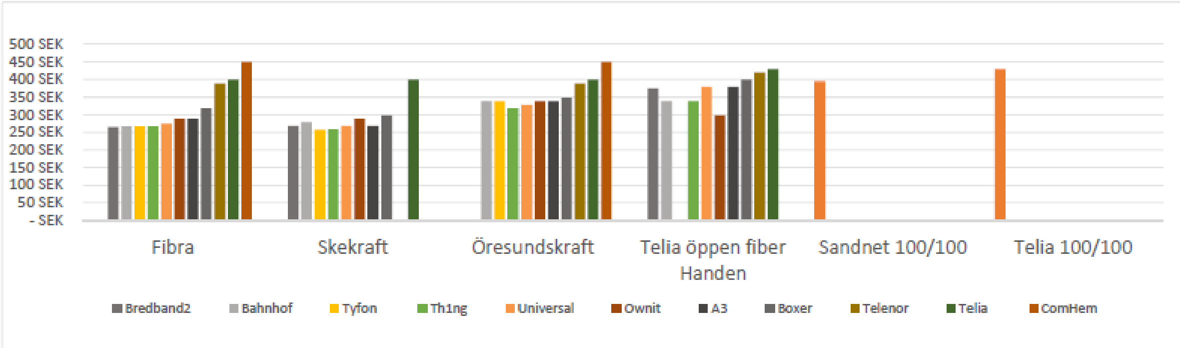
Figure 3-18: Percentage shares of OTT services used for music and video content consumption (in an average month)



Source: Representative consumer survey (2017); Germany, N=2036; Sweden, N=924.

Figures on retail prices for a 100/100 service available from the Swedish Local Fibre alliance (see below) show a range of service providers offering different prices on the networks of Fibra, Skekraft, and Öresundskraft, all of which operate a “communication operator” model, whereby an operator activates the dark fibre operated by the municipal network and sells the service to retail service providers. A similar range and choice of operators can be seen operating over the network of Telia Open fibre, the incumbent’s own “communication operator” solution. By comparison, the retail prices offered by Sandnet, a vertically integrated municipal network operator and Telia, are at the higher end of the range of prices offered over the wholesale only models.

Figure 3-19: Retail prices for 100/100Mbit/s broadband, selected providers in Sweden



Source: Swedish Local Fibre Alliance

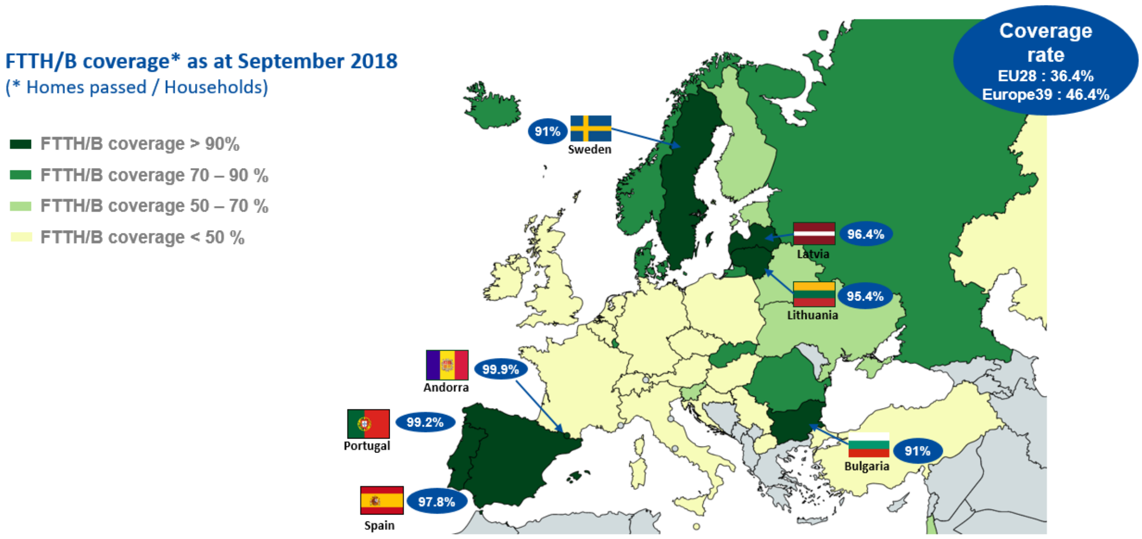
3.3 Trends in infrastructure deployment and competition

3.3.1 Expansion in full fibre networks

A key trend that has accelerated since the last Recommendation was adopted in 2014 is the deployment of full fibre networks to homes and businesses.

In the 12 months between September 2017 and September 2018 the number of homes passed in the EU28 grew by almost eleven percent from 73.2m to 81m, meaning that 36% of homes had access to FTTH/B networks.

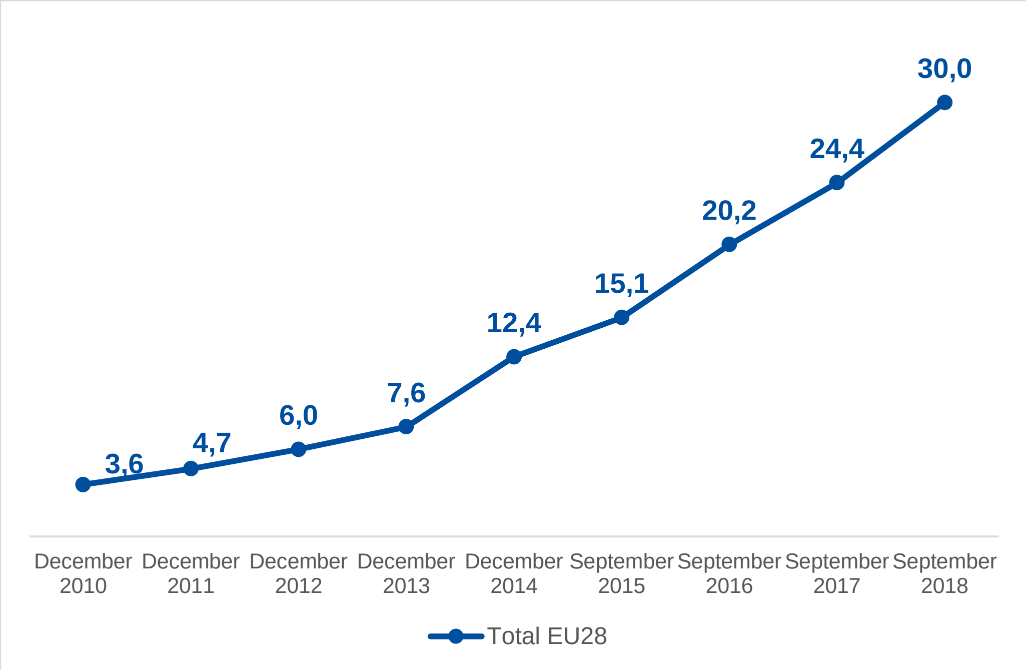
Figure 3-20: FTTH/B coverage (% of households)



Source: IDATE for FTTH Council (2019)

Within the same period, take-up increased from 24.4m to 30m, meaning that 38% of homes passed by FTTH took the service at the end of Q3 2018.

Figure 3-21: FTTH/B subscriptions (EU28, m)



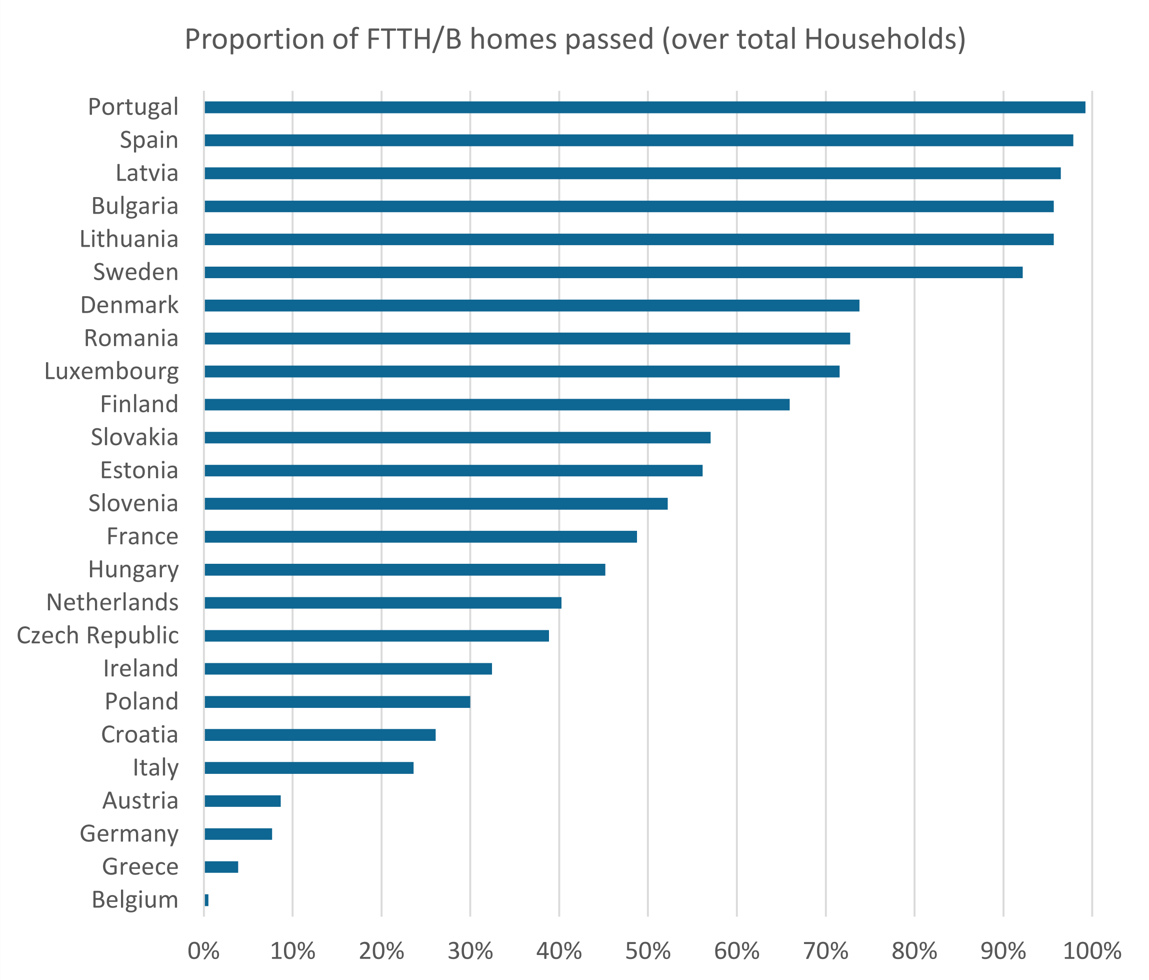
Source: IDATE

As can be seen from the map at Figure 3-20 and the chart below, the relatively low EU-wide coverage rates for FTTH conceal significant variations between EU member states. While FTTH/B coverage is high in several countries including Spain, Portugal, Scandinavian countries and much of Eastern Europe, including Latvia, Bulgaria and Lithuania, full fibre coverage remains limited in the UK, Germany, Italy and Belgium, and is patchy in France and the Netherlands.

In the case of the UK, Germany, Italy and Belgium the initial focus for the incumbent was on FTTC/VDSL, supplemented with vectoring in Germany and with G.fast in the UK. However, in recent months there has been a shift in strategy towards FTTH, with at least regional FTTH deployment targeted by incumbents in all countries, and discussions over more comprehensive plans in the UK.[122]

122 BT has announced FTTP roll-out plans until March 2021 (ISPreview 2019a). There is also an ongoing political debate about the potential subsidisation of fibre (ISPreview 2019b).

Figure 3-22: Penetration of homes passed in European countries*, December 2018



* excluding Cyprus and Malta

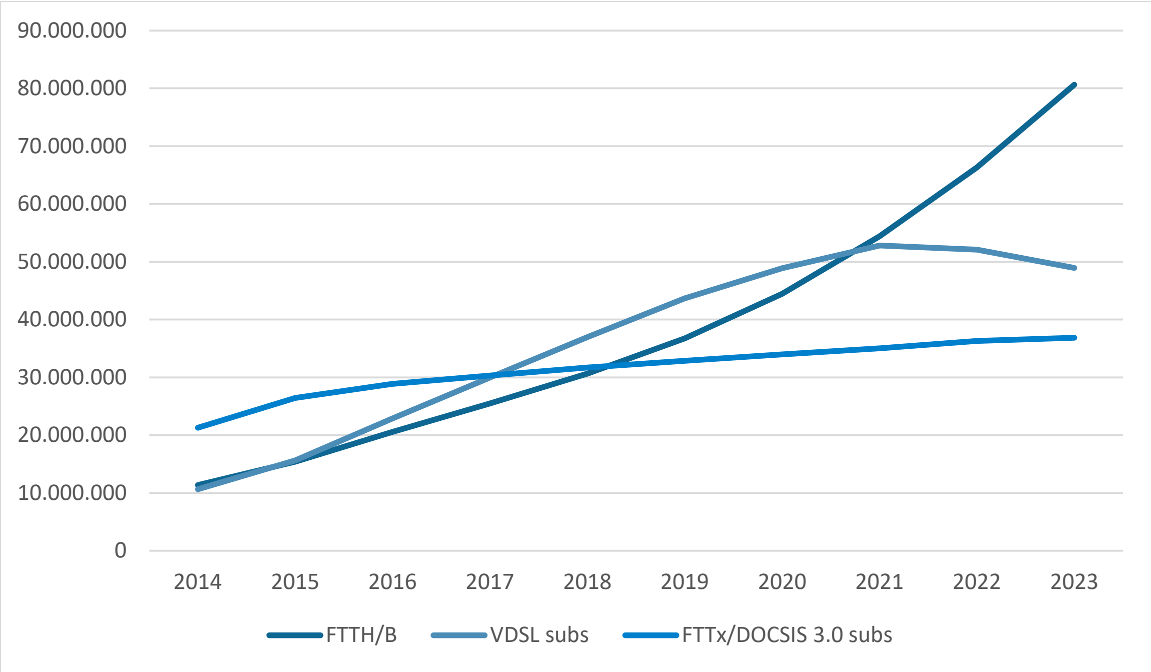
Source: IDATE for FTTH Council Europe

Cable operators, which are present across the whole of Belgium, the Netherlands and Malta, and in some regions of other countries including the UK, Germany, Spain, France, Portugal and Ireland have mainly pursued incremental investment strategies relying on the upgrade of existing networks with Docsis 3.1. However, some such as Altice in France and ONO in Portugal are understood to have deployed FTTB networks to households within their existing footprint, while others such as Liberty Global in the UK have plans to expand their existing footprint with FTTH technology.[123] It can reasonably be expected that in the period towards 2030, cable operators which have not yet adopted a FTTH deployment strategy, will move towards deploying full duplex technology, which also requires fibre densification in the network.

123 ISPreview (2019c)

IDATE forecasts suggest that FTTH/B subscriptions will overtake those based on FTTC/VDSL around 2021, and rapidly expand thereafter, while other technologies remain stable or in decline.

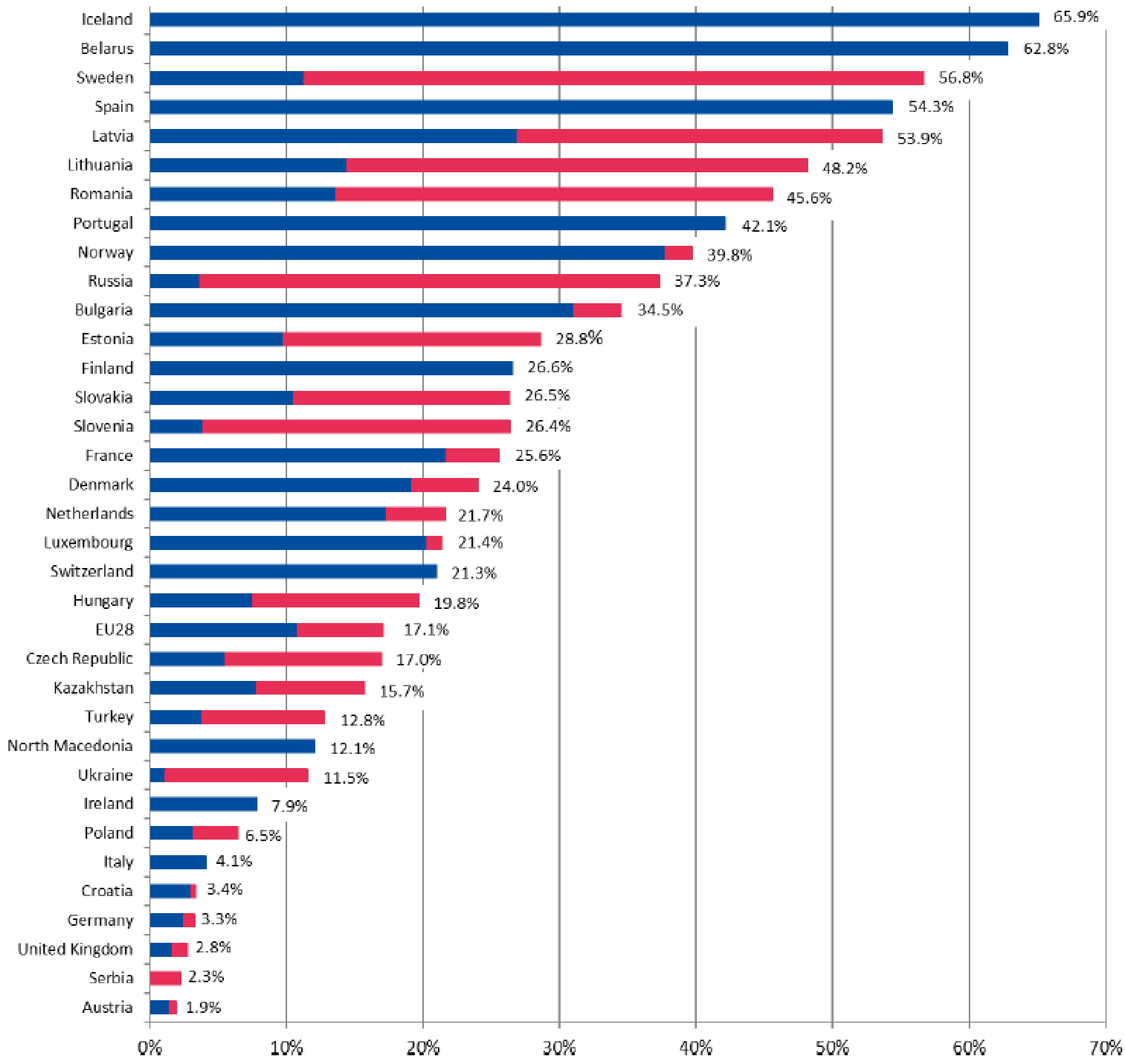
Figure 3-23: Ultra-fast broadband in EU26*, 2014-2023



* excluding Malta and Cyprus

Source: IDATE, FTTH H1 2019 database

Figure 3-24 Penetration rates of European countries, September 2019 (FTTH/B Subscriptions / Households)



Source: IDATE for FTTH Council Europe, FTTH in blue, FTTB in red

Analysis conducted by WIK in the context of a study on potential funding targets for the upcoming CEF Digital programme[124] suggests that within a 2025-2030 timeframe some gaps in FTTH coverage may remain as it is not economically viable to deploy FTTH in some regions or local areas. However, these are likely to be limited, and may be addressed if sufficient funds are made available via the CEF2 programme, structural funds and/or national state aid programmes.

124 Preliminary results available in WIK (2019d).

3.3.2 Competitive dynamics associated with fibre deployment

The potential for duplication in FTTH varies according to population density, and these variations are relevant in considering the need for geographic segmentation in the market or of remedies.

Upgrades towards FTTH require significant investments, which can affect the degree to which access networks can be profitably duplicated. There are areas which theoretical models suggest can only support a single fibre network or which are not viable at all in the absence of subsidies. However, the prospects for duplication of FTTH infrastructure can be improved, at least in dense urban areas, through duct access.

Even where end-to-end duplication of the network is not viable, choice can also be provided through co-investment or swap deals, or through regulated or commercial wholesale access.

The table below shows the degree to which WIK has estimated that end-users have a choice of retail provider on the basis of end-to-end infrastructure, co-investment/swaps and wholesaling in three countries in which FTTH has been relatively widely deployed.

Table 3-2: Estimates of choice available in ultrafast broadband provider based on parallel infrastructure and co-investment

	FTTH coverage % households (as of December 2018)	% HH with choice of 3+ ultrafast offers based on parallel infrastructure	% HH with choice of 3+ offers based on parallel infrastructure and co-investment	Availability of ultrafast bitstream offers
France	49%	~10%	~30%	Wholesale cable
Spain	98%	Not known	38% +	Available from incumbent nationwide
Portugal	99%	~36%	44% Q1 2018 ~80% possible in view of announced network sharing	Available from incumbent, low take-up

Source: IDATE, FTTH H1 2019 database, WIK[125]

The degree of viable replicability (and therefore geographic variations) could be expected to be less in countries where the incumbent access network was not historically ducted. Nonetheless, there is a possibility that other ducts and poles e.g. from utility providers could support duplication in these cases. Investigations by WIK and VVA on the availability of utility infrastructure in the context of the review of the broadband Cost Reduction Directive[126] suggest that utility ducts and poles are expected to be widely used in Italy and have been used to support rural FTTH deployments by operators in France and Portugal.

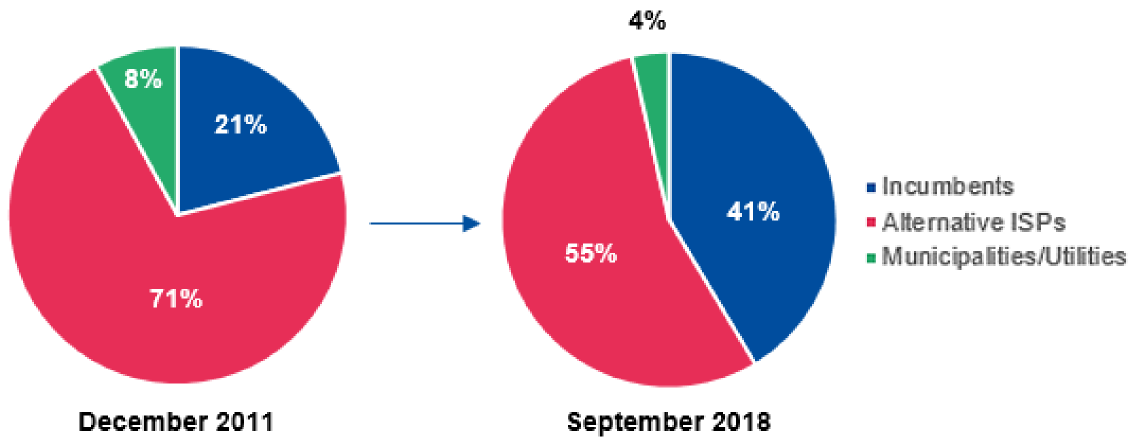
125 WIK (2019e).
126 WIK (2018c).

Utilities have also in some countries such as Denmark, Germany, Ireland and Belgium also taken advantage of their duct and pole infrastructure to deploy their own FTTH networks.[127]

The presence of cable can also limit the degree to which additional duplication is viable, and may go some way to explaining the more limited or delayed role of competitive investors in deploying fibre in countries such as the UK, Belgium and Germany.

As regards the players involved, initial deployments of fibre were made by alternative operators, with municipalities and utilities also playing a role in some cases.[128] Recent data from IDATE shows that municipal initiatives and alternative ISPs still account for the majority of deployments in terms of homes passed. However, incumbents are increasingly deploying FTTH/B infrastructures as a replacement for legacy networks. This may change the competitive dynamics associated with very high capacity broadband, especially in areas where only the incumbent has deployed these networks (or indeed where alternative operators deploy such networks and the incumbent does not intend to upgrade its own infrastructure).

Figure 3-25: Homes passed by category of player (%)



Source: IDATE for FTTH Council (2019)

3.3.3 Business models for fibre deployment

As the pressures of investment in FTTH require high market shares for viability, there has been a trend in several markets towards co-investment based on joint ventures or infrastructure swaps.

127 Orange (2019).
128 See discussion in WIK (2016b).

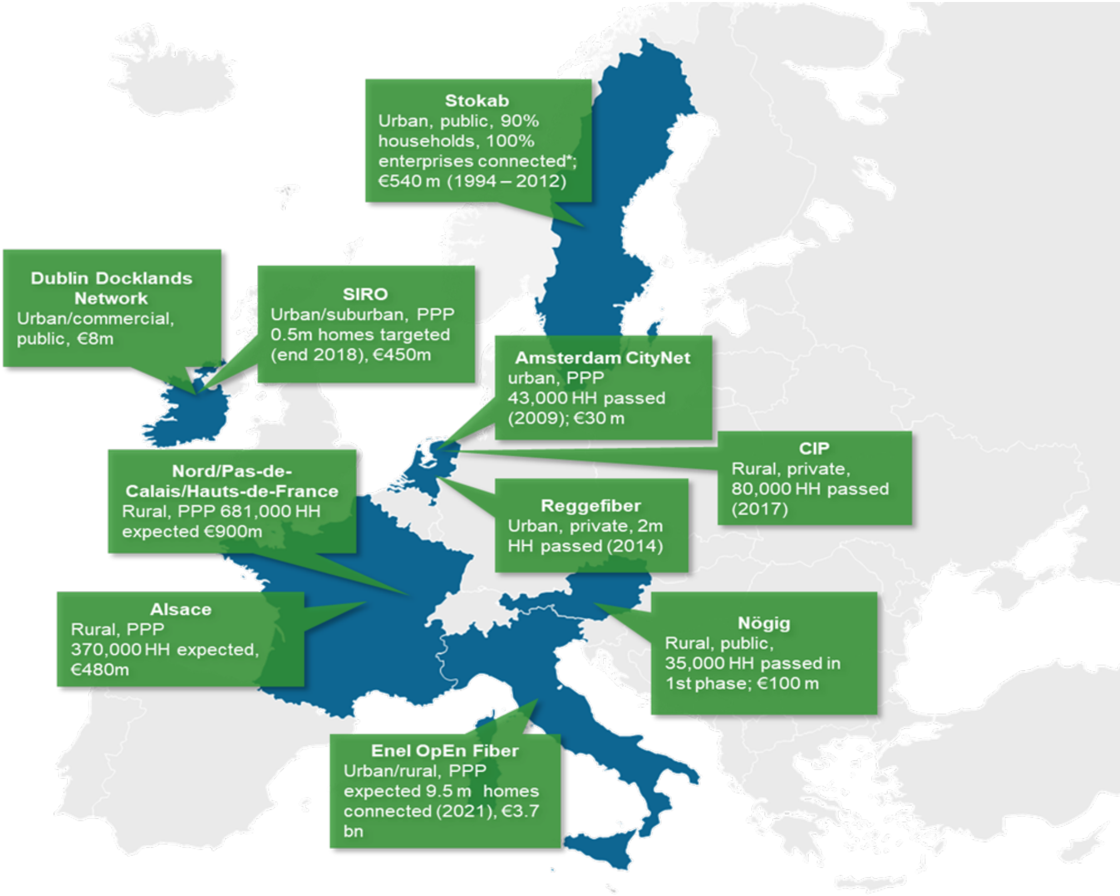
For example, in 2015, Vodafone Ireland and the utilities company ESB invested €450 million in a joint venture to roll out a 100% fibre-to-the-home (FTTH) network to small towns (with upwards of 4,000 houses) across Ireland by the end of 2018. Deutsche Telekom created a joint venture company Glasfaser NordWest in 2019, together with the utilities company EWE, to deploy FTTH in North West Germany for a total investment of €2 billion euros over the next ten years. Vodafone Spain signed an agreement with MasMovil in 2018 to jointly deploy FTTH to 1.9 million homes in the course of 4 years. Vodafone has also signed infrastructure swap agreements with Orange Spain, Portugal Telecom and NOS.[129]

Co-investment, like mobile network sharing, can – if appropriately designed foster infrastructure competition even in cases where the network itself may not be duplicated. This will need to be reflected in SMP assessments. However, it could in certain cases also raise issues around potential collusion or co-ordination.

In other countries or areas (e.g. Italy, Sweden, France Public Initiative areas), wholesale only models have emerged to aggregate traffic on fibre networks. Another supporting factor for wholesale only networks has been an influx of capital from financial investors, who see fibre networks as a utility type of asset, providing a stable stream of revenues over a relatively long expected lifetime of about 50 years. The risk – notably in less densely populated areas with low risk of overbuild – is perceived as relatively low if demand aggregation prior to roll-out is successful. Open wholesale business models are ideal to provide a predictable long-term revenue stream to such networks. The emergence of such business models may significantly impact the competitive landscape in areas where infrastructure competition is not likely to arise.

129 See discussion in WIK (2019f). Prospective competition and Deregulation

Figure 3-26: Examples of wholesale only initiatives



Source: WIK-Consult

3.3.4 Progressive switch-off of copper networks

During the period of the next Relevant Market Recommendation, it is likely that fibre will overtake copper as a primary source of electronic communications connections. Figure 3-19 suggests that this is likely to be the case already in a number of countries. While, migration in most countries has been on a voluntary basis thus far, as incumbents progressively upgrade to FTTH we can expect that copper will progressively be switched off (see early developments in the chart below). In addition to the concrete milestones set for copper switch-off to fibre in Estonia and France, the Norwegian incumbent Telenor has set a switch-off target of 2023[130] and discussions are under way on the decommissioning of the copper network in the UK and terms associated with migration.[131]

130 MyNewDesk (2019).

131 Copper to fibre migraton is one of the issues discussed in the Ofcom 2020 Consultation on the Wholesale Fixed Telecoms Market Review

Table 3-3 Status copper switch-off

	start	2018	2020	2023	2030	Replacement technology
Estonia	2015	70%	R			FTTH (50%), fixed wireless (10%) FTTC (40%)
Sweden	2009	42%				Fixed wireless
Spain		2%	7.40%			FTTH
Portugal					R 75%	FTTH
Italy		0%		P 60%		FTTC
France	2023	0%	0%	start	100%	FTTH
Netherlands		0%				6 FTTH (pilot) in 2018
Germany		0%				No plans
Poland		0%				No plans
UK		0%		2027-30		Plans in consultation phase

R=regional switch-off, P=partial switch-off (feeder segment)

Source: WIK Consult

The removal of copper as a potential “constraint” for fibre-based service competition, as a result of both voluntary and forced migration, could affect competitive dynamics in the provision of VHC broadband (if there is a chain of substitution).

3.4 Developments in mobile and wireless deployments

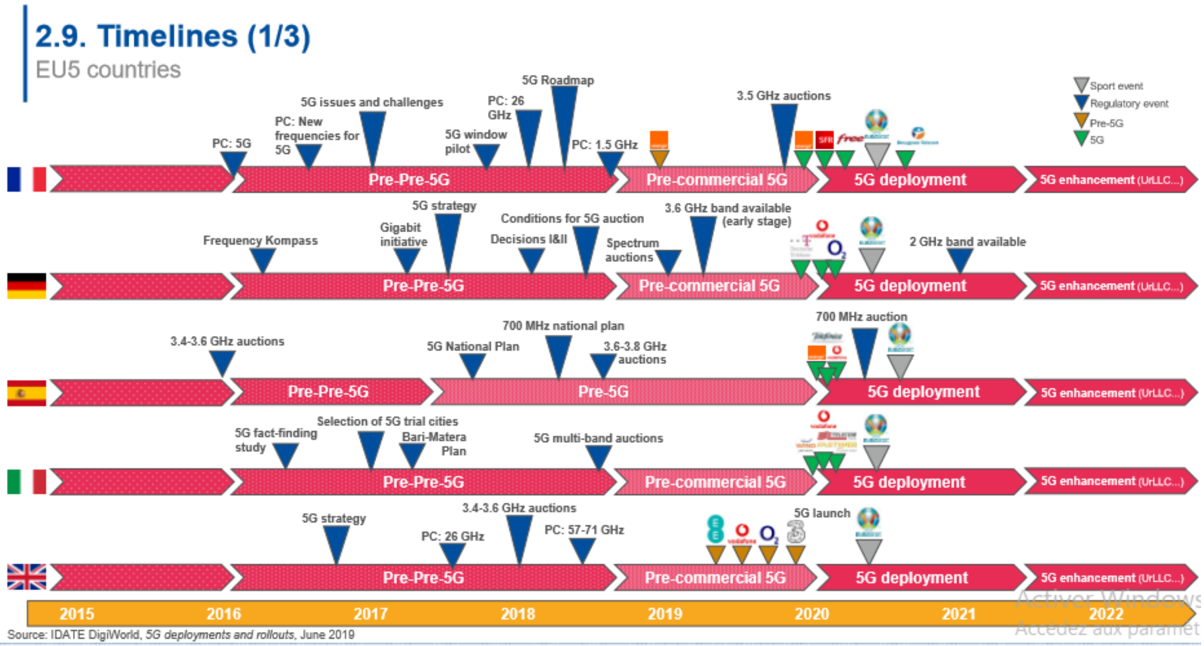
3.4.1 Deployment of 5G

5G will allow for the provision of higher bandwidth and will also provide tailor-made services from operators for the different requirements of different verticals in terms of latency, reliability, bitrates, end-to-end service levels.

Elisa was the first European telecom operator to begin the commercial use of 5G services in June 2018, by opening a 5G network between Tallinn (Estonia) and Tampere (Finland), for speeds up to 2.2Gbps. Elisa then participated in the spectrum auction in the 3.4-3.6 GHz bands in Finland in October 2018 and started pre-sales of its 5G offer in May 2019. EE, in the UK, was the second operator to launch 5G services in May 2019 (5G Home service, 5G Wifi service, 5G mobile service) in six UK cities, and plans to add 16 additional cities by the end of 2019. Vodafone UK followed in July 2019.

All other telecom operators are actively building their 5G networks. In late 2018, Orange started to announce detailed plans regarding 5G network deployment and commercial launch. In 2019, 5G deployments are expected with tens of base stations in many cities across Europe. Various operators (Vodafone, EE, Orange, DT…) have already announced deployments in many European cities. Contracts with network suppliers for 5G equipment should be signed in 2019 in order to allow full commercial service in 2020. In Austria, T-Mobile announced in March 2019, commercial launch with friendly customers in rural areas.

Figure 3-27: 5G deployment timeline in the EU5 markets



Source: IDATE DigiWorld, *5G deployments and rollouts*, June 2019

In terms of commercial launches, the UK started the launch of 5G services in 6 cities in May 2019, followed by Spain and Italy in June 2019, with 5G services launched in 15 and 5 cities, respectively, and Germany in September 2019 (with 5G services available in 5 cities). Among the former EU5, France is the only country which has yet to launch 5G services.

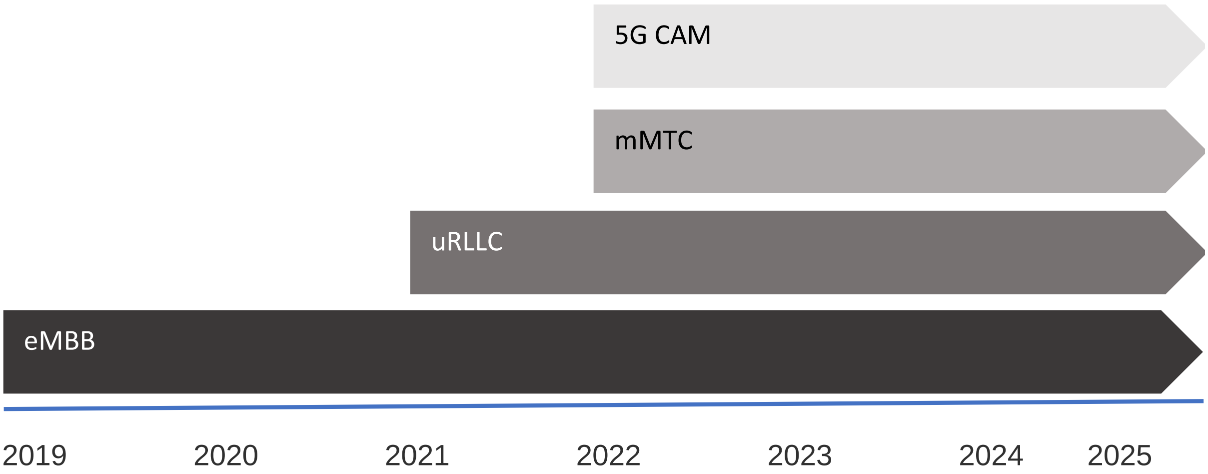
Table 3-4: Status of auctions for 5G spectrum

Country	700MHz	3.5GHz	26-28GHz
France	Auctioned in December 2015 for a availability in 2019	Auction planned in H2 2019/H1 2020	Probably 2020
Germany	Auctioned in June 2015 for an availability in 2019	Auctioned in March-June 2019	H2 2019/H1 2020
Italy	Auctioned in October 2018 for an availability in 2025	Auctioned in October 2018	Auctioned in October 2018
Spain	Auction planned in Q1 2020	Auctioned in 2016-2018 for 4G	Auction planned in 2020
UK	Auction planned in 2020	Lower part auctioned in April 2016. Upper part planned for 2020	Auction planned in 2020

Source: IDATE DigiWorld

It should be noted that although 5G services are likely to be made available in certain areas in the relatively short term, initial 5G services will mainly be focussed around enhanced mobile broadband and potentially 5G FWA. 5G deployments capable of supporting ultra-reliable low latency communication (**URLLC**) and connected automotive mobility (5G CAM) are likely to take longer, and may only enter into widespread use in the middle of the next decade.

Figure 3-28: Potential timeframe for 5G services



Source: IDATE

List of acronyms used:

CAM: Connected Automotive Mobility

mMTC: massive Machine Type Communications

uRLLC: ultra Reliable Low Latency Communications

eMBB: enhanced Mobile Broadband

3.4.2 Implications of 5G deployment for competition

Deployment of 5G, and especially small cells, are likely to increase the need for fibre backhaul, deeper in the network. This is turn raises questions over whether such backhaul can be competitively deployed or acquired in the market, or may require regulatory intervention.

The economics involved in 5G deployment alongside potential electromagnetic fields (EMF) constraints, is also likely to increase demands for network sharing, which may have implications for competition.[132]

Another issue that may arise with the deployment of 5G is how and by whom specialist applications and IOT solutions for the industry will be provided. MVNO/As currently play a role in the provision of cross-border IOT solutions, and may require access to and/or roaming on network slices to deliver services in a 5G environment.[133] Meanwhile,

132 PTS (2019a). WIK also prepared a study for the Danish regulatory Authority DEA on this subject, which is pending publication.

133 See WIK (2019a).

standardisation and interconnection between different network slices will also be important to deliver services which are inherently cross-border such as Connected Automotive Mobility.[134]

Some experts and equipment manufacturers have called for open APIs as a means to support competition and innovation in applications on 5G networks.[135]

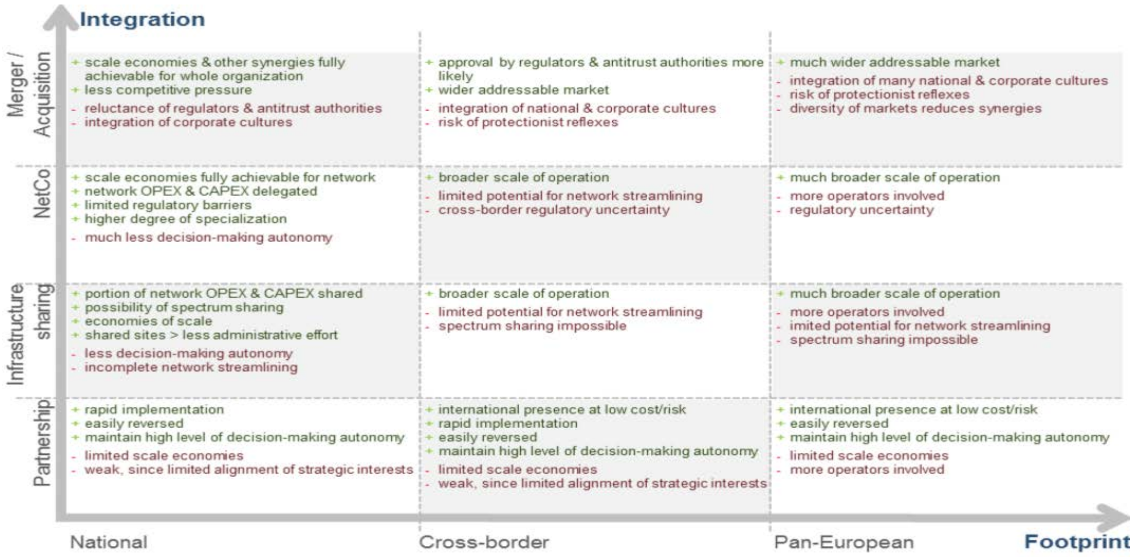
3.5 Market consolidation and convergence

European markets have seen a number of mergers and acquisitions over the last years. There are several reasons operators have sought to consolidate, mainly within their national market.

The market environment has been challenging for many years with falling revenues and profits, while at the same time operators are facing the need to invest in FTTx networks, and new generations of mobile technology. These pressures have been cited in a number of merger proceedings brought by mobile operators seeking to consolidate to bolster their market position and reduce the number of players in the market – typically from 4 to 3.[136]

The following figure illustrates some of the drivers and challenges associated with consolidation in Europe.

Figure 3-29: Drivers and hurdles for consolidation in Europe



Source: IDATE

134 See TNO (2019).
135 See for example Lemstra (2019) as well as comments on this subject by Nokia (2019d).
136 See GSMA Intelligence: market consolidation aims to address rising investment costs for European operators https://www.gsmaintelligence.com/research/?file=0e4de8706e4172109db8d44e0f26cf87&download

Another major stated driver for consolidation between operators acting in different markets is fixed/mobile convergence. Convergence is taking place at different layers. On the commercial, side, fixed/mobile bundles are increasingly popular with consumers (see section 3.1.2.1). Convergence is increasingly relevant at the network layer too. For instance, it is already the case that a major part of the traffic generated by mobile devices is channelled through fixed networks via wifi-offloading. Although much offloading in the home or workplace is conducted via the end-users' device independently from the mobile network, mobile operators themselves are also in several cases making use of offloading to a fixed network to reduce costs and increase bandwidth and reliability.[137] As the amount of mobile data generated continues to grow, more and more fibre is needed in the backhaul to handle large traffic flows. This situation will be reinforced by 5G networks, which will require denser networks with smaller cells and thus more cell sites. Indeed, ongoing research, as commissioned by the FTTH Council, shows that there are very significant synergies for integrated full fibre/5GB greenfield deployments.

Pure-play fixed or mobile players therefore have shown strong incentives to merge with a complementary player or miss out on important synergies.

Consolidation implies a risk of reduced competition and the emergence of oligopolies at retail level. However, through the emergence of bigger players, it may also alter the balance of negotiating power between dominant players and the newly merged entity in the latter's favour as well as increase the operator's buying power vis-à-vis the limited number of vendors.

Even in cases where mergers do not occur or are not permitted by the competition authorities, there are likely to be increasing trends towards "soft" consolidation via "co-investment" agreements and network sharing, potentially backed by joint ventures. Some examples of joint ventures include the JV between Orange and Deutsche Telekom in the UK to create the cellular operator EE in 2010 (acquired by BT in 2016) and the JV between Vodafone and Ziggo (Liberty Global) in the Netherlands in 2016 to provide fixed-mobile convergence services. Moreover, Meteor in Ireland benefited from the merger between H3G and O2 in 2014 to develop its 4G network in joint use of infrastructure with H3G, as part of the commitments to which the merger is conditional. Finally, in terms of FTTH network deployment, Orange and Vodafone in Spain have been investing jointly for country-wide expansion and coverage.

We expect that there will be an increasing role for regulators in assessing the implications of these developments on competition, in the course of the market analysis process, or in the context of assessing whether co-investment arrangements meet the arrangements prescribed in the Code under which there would be forbearance from ex ante regulation of VHC networks.

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137 For a discussion of mobile offloading to WiFi see chapter 4 in Ecorys et al. (2020).

4 Regulatory and legal developments

Alongside technological and market developments, there have been a number of important regulatory and legal developments that require consideration in the context of the review of the Relevant Markets Recommendation.

We consider regulatory developments in section 4.1. Legal developments are discussed in section 4.2

4.1 Developments in legislation relevant to the Relevant Market Recommendation

4.1.1 Implications of the SMP Guidelines

First, the revision of the Relevant Market Recommendation will need to take into account the provisions of the 2018 SMP Guidelines and the accompanying staff working paper.

Changes introduced under the revisions introduced to the original 2002 SMP Guidelines by the 2018 SMP Guidelines may not have changed much of the substance of the market definition process, but have changed certain key elements of emphasis in the methodology used to determine the existence of competitive constraints and the existence of market power. Some of those key changes and similarities include the following:

- Whereas the 2002 Guidelines emphasised the interests of European citizens, the 2018 Guidelines place a greater emphasis on the development of the internal market in the electronic communication sector through the development of **consistent regulatory practice** and a consistent application of the Regulatory Framework.

- Both sets of SMP Guidelines emphasise that NRAs should carry out a market-based assessment with a forward-looking, structural evaluation of the relevant market, which requires a **dynamic rather than a static approach**.

- There is greater emphasis in the 2018 SMP Guidelines on the methodology to be used by NRAs under the **Modified Greenfield Approach.** Emphasis is also placed in the 2018 SMP Guidelines on the fact that, if there is effective competition on the relevant retail markets, the NRA should conclude that regulation is no longer required at the wholesale level.

- Given that significant technological changes have occurred over the past 15 years in electronic communication markets, the 2018 SMP Guidelines add that product substitutability between different services may arise through the **increasing convergence of various technologies**, which often allows operators to offer similar retail product bundles. In addition, it emphasises that **OTT-based services have emerged as a competing force to certain retail services**. Nevertheless, irrespective of these technological developments, the underlying methodologies and analytical tools used in the assessment of market boundaries should remain the same.

- Although the 2002 SMP Guidelines mentioned the concept of ‘chain substitutability’, the 2018 SMP Guidelines further elaborate upon the scope of this concept within the context of electronic communications networks and services. They do so by being explicit that **different generations of technology are considered to fall within the same relevant product market as their predecessors, in particular when they do not enable different services but only lead to an improvement in their quality and capacity**, even though prices for previous or current generation technologies can constrain prices for future generations.

- Both sets of SMP Guidelines express the view that in the electronic communications sector, the geographic scope of the relevant market has traditionally been determined by the physical area covered by the network under scrutiny and the existence of legal and other regulatory instruments. In addition, the 2018 SMP Guidelines add that NRAs should ensure that **geographic market units should be of an appropriate size, able to reflect the network structure of all relevant operators and should maintain clear and stable boundaries over time**. In addition, if regional differences are found to exist between networks, but are not considered to be sufficient to warrant the identification of different geographic markets or SMP findings, NRAs may pursue **geographically differentiated remedies**.

- In the assessment of Significant Market Power, the 2018 SMP Guidelines now emphasise that the ability of new entrants to increase their market share quickly may also reflect on that the market in question is more competitive, and that entry barriers can be overcome within a reasonable timeframe, which reflects the administrative practice of the European Commission.

- Both sets of SMP Guidelines list a number of non-exhaustive criteria with which to measure market power. When compared to the list of criteria provided in the 2002 SMP Guidelines, the 2018 version adds a number of additional criteria such as barriers to entry, commercial advantages or superiority (not only technological), direct and indirect network effects, the conclusion of long-term and sustainable access agreements, and engagement in contractual relations with other market players that could lead to market foreclosure. The 2018 version also draws a distinction between the overall size of the undertaking and its relative size vis a vis competitors.

- Whereas the 2002 version of the SMP Guidelines emphasised the importance of legislative or regulatory entry barriers, its 2018 version also refers to the “technological” barrier created by the lack of available spectrum. However, both sets of Guidelines emphasise that, due to ongoing technological progress, competitive constraints can come from innovative threats of potential competitors not currently active in that very market.

- The 2018 SMP Guidelines emphasise that market entry in the electronic communications sector is more likely to occur where the potential new competitor is already present on a neighbouring market. This provision replaces the ‘leveraged market power’ classification found in the 2002 SMP Guidelines.

- The discussion of the doctrine of ‘essential facilities’, given that it is of no consequence for the purposes of applying ex ante obligations, is omitted from the 2018 SMP Guidelines.

Arguably the most important change between the 2002 and the 2018 versions of the SMP Guidelines is the treatment of the concept of “joint SMP” or the concept of “collective dominance” in the context of Article 102 TFEU. Under the new approach, greater emphasis is placed on the **structural characteristics of electronic communications markets which might render them more conducive to tacit collusion through the alignment of the business incentives of the parties**. In this regard, emphasis is placed on the Airtours Judgment of the General Court, which sets forth the three cumulative conditions that are necessary to determine a finding of collective dominance (i.e., transparency of market conditions, the existence of a credible deterrence mechanism and the lack of an effective external competitive constraint) as interpreted by the Impala II Judgement of Court of Justice.

4.1.2 Provisions of the Electronic Communications Code and Broadband Cost Reduction Directive

The following provisions in the Code and the Broadband Cost Reduction Directive are relevant for the analysis of broadband and business access markets, and will need to be reflected in the upcoming Recommendation:

- The Code includes a new core objective (Article 3(2)) for the Commission and NRAs to promote connectivity and access to, and take-up of, **very high capacity networks**, including fixed, mobile and wireless networks, by all citizens and businesses of the Union. This objective needs to be taken into account, alongside the need to promote competition, consumer welfare and the internal market, when considering which markets may be susceptible to ex ante regulation.

- Article 67(5) of the Code has **extended the period between market reviews** from 3 to 5 years. This requires the Commission in the context of the relevant market review and NRAs to take into account a horizon up to 2025 and even beyond when considering which markets may be susceptible to ex ante regulation. From a practical perspective, this means that the deployment of 5G and expansion of fibre, as well as the gradual decommissioning of copper in some countries, will need to be fully taken into account. It may also lead towards markets being defined in a more flexible manner so as to take into account potential developments within the review period.

- Article 22(1) of the Code requires NRAs and other competent authorities to proceed to the **mapping of existing infrastructure and forecasts** for future deployment by 21 December 2023. Conclusions reached in the relevant market recommendation on appropriate criteria for geographic segmentation, and particular the coverage of given technologies and number of overlapping networks, should ideally be reflected in the data that should be gathered by relevant authorities in the context of mapping and forecasts. (See also Recitals 9/20 of the Broadband Cost Reduction Directive).

- The Code includes provisions for the **sharing of certain network elements including (but potentially extending beyond) in-building wiring on a symmetric basis**. The sufficiency of these remedies in addressing competition concerns will need to be taken into account when assessing the case for the imposition of additional SMP regulation. (Article 44(1) of the Code). The provisions of the Code and relationship between symmetric and SMP regulation are further explored in section 5.1.6.1.

- The greater impetus given to **co-investment models** potentially generates greater challenges to incumbents and may have implications for the development of competition in certain markets. It is possible that, in certain cases, the impact of co-investment may be such that the market structure may tend towards effective competition at the retail level, meaning that points 2 of the 3 criteria test incorporated in article 68 of the Code would not be met. Articles 68 and 73 of the Code also require NRAs to take account of commercial agreements including co-investment when considering the imposition of SMP obligations, whereas article 76 requires forbearance on SMP access to VHC networks when co-investment arrangements satisfy certain conditions, which will be elaborated in Guidelines to be developed by BEREC.

- The Code implies that competitive conditions may be improved in cases where VHC infrastructure is deployed by "**wholesale only" operators** with consequences for the regulatory regime applied ('lighter touch regulation') It should therefore also be considered whether the presence of such players in some markets is likely to affect prospects for sustainable competition, and if so under which circumstances.

- **Priority has been conferred in the Code to duct and pole access** before other remedies are considered, and the Code makes it explicit that duct and pole access may be mandated even if not included within the definition of a relevant market. (Article 72(1) of the Code). The priority given to duct and pole access under the Code may be relevant in considering whether to define a specific market for this purpose. The focus on DPA and infrastructure-based competition also implies that there may be a potential for certain markets to become competitive downstream of DPA.

- At the same time, the 2014 **Broadband Cost Reduction Directive provides an alternative route for requesting duct access from utilities**, as well as telecommunications operators. The Directive also aims to reduce the barriers to deployment and infrastructure competition by streamlining processes for rights of way and encouraging co-deployment. The actual or potential success of this Directive in reducing bottlenecks to competition will need to be considered in assessing the degree to which markets may become prospectively competitive in the absence of SMP regulation. (Recital 29 of the Broadband Cost Reduction Directive)

Another important provision is Article 75 of the Code, which sets **maximum tariffs for fixed and mobile voice termination services across the EU (the Eurorate)**. This should be taken into account when considering whether fixed and mobile termination should additionally be considered susceptible to SMP regulation.

The new procedure (Article 66) for the **identification of transnational demand** could also lead to the identification of retail markets which have a transnational dimension, which in turn may affect the manner in which associated national wholesale markets are defined.[138]

Lastly, under Article 79 of the Code, the possibility of operators arriving at **negotiated regulatory settlements** (similar to those brokered in competition law settlements to resolve investigations under Article 102 TFEU) raises the possibility of divergent paths being taken by various EU Member States in their patterns of regulation. It may also be relevant to consider how such negotiated settlements impact upon the market analysis process.

4.2 Legal developments

In addition to reflecting changes to the ex ante regulatory Guidelines and Framework, the review of the Relevant Market Recommendation should also reflect relevant case-law under the EU Merger Regulation (EUMR), abuse of dominance under Article 102 TFEU and State aid policy. For example, the Commission's administrative precedents in its review of mergers have to a very large degree taken a similar approach to that adopted under ex ante regulation in the identification of electronic communications markets. Having said that, there is also a widespread tendency of merger precedents to explore market definitions which are narrower in their scope than the regulatory ones, and which consistent with the terms of the 1997 Market Definition Notice (itself due to be revised in 2020), are driven fundamentally by a demand-side analysis as well as by the need to assess the exact constraint that the parties to a merger exert on each other.

Furthermore, one particular recent precedent at national level - the Judgment of the Dutch Trade & Industry Appeals Tribunal of 17 March 2020 - highlights the inherent difficulties in applying a collective SMP analysis where the relevant retail market affected by such an analysis is drawn widely to include bundled offerings. In such circumstances, the identification of a focal point which can support a finding of tacit collusion will be difficult to sustain.

From the perspective of geographic market definition, the Commission has largely followed the classic legal test set forth in *United Brands Case*[139] in 1978 and the principles set forth

138 For example, a finding that there is transnational demand for a specific product may prompt the need for a more closely aligned product market definition at national level

139 The Court of Justice identifies a relevant geopgraphic market by reference to: "*a clearly defined geographic area in which [the product] is marketed and where the conditions for competition are sufficiently homogenous for the effect of the economic power of the undertaking concerned to be able to be evaluated*".

in the 1997 Notice on Market Definition, although a potential competition analysis has been primarily undertaken at the level of assessment of the effects of the merger).[140]

4.2.1 Merger Control Practice

In considering the approach to be taken by the Commission to market definition and market analysis under the revised Relevant Markets Recommendation, the Study Team has reviewed a number of merger control Decisions which have been adopted over the past five years in the electronic communications sector since the last revision of the Relevant Markets Recommendation in 2014.

Since 2014, the Commission's merger practice under the EUMR has increasingly embraced the approach taken by the Commission to market definition under its regulatory powers. Thus, in relation to voice services provided at a fixed location, the Commission under its merger practice essentially examines the retail markets for fixed voice telephony for both residential and non-residential customers. For example, at the wholesale level, the Commission assesses the respective markets for call origination on public networks at a fixed location, the market for call termination at a fixed location, and the market for call termination on mobile networks, local Internet access at a fixed location for specific customer groups (i.e., the wholesale Internet connectivity/backhaul/leased lines market), and wholesale central Internet access at a fixed location for the mass market.

Of course, given the advent of emerging technology, the broader spectrum of available products and services, the expansion of infrastructure, changing patterns of customer demand and behaviour, and changing business models of suppliers, recent merger cases have identified many market segments and additional relevant markets, especially at the retail level, over the past five years. Indeed, the Commission has, under its merger practice, identified a total of 27 relevant markets in the cases that we have considered. Of those 27 identified relevant markets, 11 of these have been at the retail level and another 16 have been at the wholesale level. For 7 of these 27 markets, the Commission has left the precise market definition open, especially where multi-play services are involved, as given that the precise market definition to be adopted was unlikely to have a material impact on the competitive assessment in the case. In particular, with regard to retail mobile telecommunications services, the retail supply of fixed Internet/broadband access services, and the retail supply of TV/television services, the Commission's relevant markets assessments have considered a wide range of segmentation possibilities. The market definitions considered in the merger precedents are further elaborated below by reference to their regulatory equivalents (points A-G below).

140 Refer to paragraph 13 of the Notice, which establishes potential competition as a relevant criterion, along with demand substitutability and supply substitutability, in the process of defining relevant markets.

Of particular relevance in the Commission's merger practice is its tendency to consider copper-based and fibre-based networks as competitive alternatives. In so holding, it has taken the view that the choices by consumers between Internet access services at the retail level turn on issues such as price and speed, rather than on the different technologies available on the market to deliver such services.[141] Indeed, most markets are likely in the short to medium term to continue experiencing the co-existence of copper and NGA networks, with copper networks continuing to predominate at present.[142] Beyond market definition issues, the process of merger control has also focused on the number of actually available access options as a sign of prevailing competitive market conditions and as a relevant indicator of the scope of the relevant geographic market.[143]

A. Retail market for access to the public telephone network at fixed location for residential and non-residential customers

In its assessment of this relevant product market under the 2014 Markets Recommendation, the Commission was prepared to take into account Voice-Over-Broadband ("VOB") and, in relation to managed VoIP, the expansion of faster Internet access technologies allowing improved VoIP, and greater convergence between mobile and fixed telephony services (especially "home zone" services). The approach adopted by the Commission under sector-specific regulation is also reflected in the Commission's practice under the EUMR, with all merger control decisions that have assessed the fixed telephony market having concluded that mobile telephony and fixed telephony services do not form part of the same relevant product market, but should instead be considered to be complementary. While the 2014 Recommendation takes into consideration the possibility of including home zone services and VoIP within the same relevant product market, it does not take a definitive view on the issue. The approach taken under merger reviews differs slightly insofar as the fixed telephony markets under a merger review include all forms of VoIP within the relevant product market,[144] while implicitly accepting that home zone services might in principle also fall within the scope of the same relevant product market. In two merger control

141 For example, refer to Case M.8864 - *Vodafone/Certain Liberty Global Assets*, esp. at paras 147, 504, 596 and 1508; *cf*. Case M.7758 - *Hutchison 3G Italy/Wind/JV*, esp. at paras 92 and 206; *cf*. Case M.7421 - *Orange/Jazztel*, at paras 46.

142 See, for example, Case M.7421- *Orange/Jazztel*, at paras 212, 222, 609-612.

143 The clearest exposition of this arguably found in Case M.7421 - *Orange/Jazztel*, where the merger of two of the four prevailing national wholesale providers was regarded as significantly limiting the amount of wholesale access options available to alternative operators. Similarly, in a number of 4-to-3 mobile sector mergers, the loss from the market of one mobile network operator (MNO) as a result of the merger was considered by the Commission to provide mobile virtual network operators (MVNOs) with less choice host networks, hence placing them in a weaker negotiating position to obtain favourable wholesale access terms. In those cases, the remedy packages therefore required the introduction of a new potential access option to restore the pre-merger balance in negotiated access options. See Case M.7758 - *Hutchison 3G Italy /Wind/JV*, at paras 876-899; *cf*. Case M.7612 - *Hutchison 3G UK/Telefónica UK*, at paras 2023, 2033, 2064, 2188 and 2871; *cf*. Case M.6992 - *Hutchison 3G UK/Telefónica Ireland*, at para. 974ff. By contrast, however, a remedy along such lines was not required where the merger was unlikely to result in worse wholesale access conditions for MVNOs than prevailed pre-merger; see Case M.7637 - *Liberty Global/BASE Belgium*, at paras 436-454.

144 See Case M.8864 – *Vodafone/Certain Liberty Global Assets;* Case M.7421 – *Orange / Jazztel*; Case M.8792 – *T-Mobile NL/Tele2 NL*; Case M.7978 – *Vodafone / Liberty Global / Dutch JV*; Case M.7000 – *Liberty Global / Ziggo 2018*.

decisions,[145] the Commission has considered two possible sets of segmentation, namely, residential vs non-residential on the one hand[146], and local/national/international calls on the other, while ultimately leaving the market definition open for both sets of segmentations.

B. Wholesale call origination on the public telephone network at a fixed location

The Commission has not needed to assess the market for call origination on the public telephony network in any of the merger control cases considered by the Study Team. The 2014 Recommendation takes the position that, at the retail level, call origination is usually offered together with narrowband/broadband access. At the wholesale level, however, the distinction between broadband access and call origination continues to be drawn. As recent current merger practice has not needed to consider the wholesale market for call origination, it would not be unreasonable to assume that, should bundles be deemed to form distinct relevant markets, both services could form parts of a bundled wholesale market.

C. Wholesale fixed and mobile call termination markets

The assessment conducted in the 2014 Recommendation coincides with that taken under current merger practice. Each network of a terminating operator is understood to comprise a separate relevant product market. The merger cases and the 2014 Recommendation both confirm that the Commission is willing to identify a separate relevant product market for call termination to non-geographical numbers.

D. Retail mass market for access to data at a fixed location

The 2014 Recommendation defines a retail mass market for access to data at a fixed location, based on characteristics such as the type of customer, the technologies used, whether delivered via fixed or mobile means, the role of OTTs in supplying the service, and the possibility of multi-play segmentations. In particular, the Commission emphasises the importance of analysing the different needs of private and business customers, the differences in technology used, the growing influence of OTT services, the differences between mobile Internet access (LTE) options and the limits to such technology, and the possibility of non-fixed line technologies acting as substitutes (e.g., Wifi, mobile). In addition, the Commission discusses the increase in multi-play services in relation to fixed access to data. However, the Commission in its 2014 Recommendation does not take a definitive position on the market definition issue regarding the provision of bundled service offerings, leaving open the question of the precise market definition. When considering whether customer segmentation is appropriate, the Commission advises NRAs to examine supply-side dynamics and to verify whether operators can readily provide higher quality services.

145 Refer to Case M.7421 – *Orange / Jazztel*; Case M.7978 – *Vodafone / Liberty Global/Dutch JV*.

146 This segmentation has also been considered in Case M.8864 – *Vodafone/Certain Liberty Global Assets*, but left open.

In its merger practice, the Commission has consistently assessed the relevant market definition for retail fixed Internet/broadband access along similar lines to those advocated by the Commission in its 2014 Recommendation. In addition to the above segmentation possibilities, the speed of service delivery has also been taken into consideration. As put forward in the 2014 Recommendation, there is still a distinction that can be drawn in practice between fixed and mobile Internet access. In two particular cases, separate markets for large enterprises were identified.

E. Retail high-quality market for access to data at a fixed location

Retail business connectivity/communications services refer to services of higher quality and with specific features that are directed towards business customers, which private customers do not require. The 2014 Recommendation focuses on the specifics of the services in question and the technology required for the provision of such services, such as LLU and Ethernet connections, the availability of dual-connectivity over different infrastructures, high bandwidth connections, short repair times, etc. In practice, these elements have also been taken into account by the Commission under its merger practice, where it has analysed a potential segmentation between SOHOs (Small Offices and Home Offices), SMEs and LEs (Large Enterprises), but it has ultimately left open the segmentation question as it was not considered capable of affecting the outcome of its assessment.[147] In its 2014 Recommendation, as in the Commission's merger practice, future market trends in light of the deployment of NGAs are considered in the process of market definition.

F. Wholesale local Internet access at fixed location ("WLA") specific customers (Wholesale internet connectivity/backhaul services/leased lines market)

In the 2014 Recommendation, the Commission defines an overall wholesale market for local Internet access at a fixed location (WLA). This market definition is not, however, reflected in the current merger practice of the European Commission. Rather than identifying a broadly defined WLA fixed market, the Commission's merger practice has identified three separate product markets that comprise those separate access products associated with the WLA market, namely, the wholesale markets for Internet connectivity, backhaul services, and leased lines.[148] Each of these markets identified in EU merger practice reflect different segments of the WLA market defined for regulatory purposes. The products that fall within the product market identified for regulatory purposes include bitstream and virtual access, the control of core network elements, dedicated logical connections, and LLU-like services.

G. Wholesale central Internet access at fixed location (wholesale market fixed internet/broadband services)

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147 See, for example, Case M.7978 – *Vodafone / Liberty Global / Dutch JV*; Case M.7000 – *Liberty Global / Ziggo 2018*.

148 For example, refer to Case M.8864 – *Vodafone/Certain Liberty Global Assets;* Case M.8792 – *T-Mobile NL/Tele2 NL*; Case M.7978 – *Vodafone / Liberty Global / Dutch JV*; Case M.7758 – *Hutchison 3G Italy / Wind / JV*

The wholesale market for central Internet access, as defined in the Commission's 2014 Recommendation, corresponds to the wholesale fixed Internet/broadband market identified in the Commission's merger practice. In doing so, the Commission has had to consider the technical capabilities of various technologies, such as FTTH, FTTC/VDSL, LLU, and CATV connections. In practice, possible segmentations along the lines of LLU Bitstream and the resale of the fixed incumbent's broadband offering have been considered under the merger review process,[149] but ultimately the market definition has been left open in all the cases considered by the Study Team. Thus, the general approach adopted by the Commission under the merger review process appears to be similar to that adopted under the practice of NRAs in applying the 2014 Recommendation. Moreover, both the regulatory and the merger review practices seem to confirm that the impact of future technological trends, such as the expansion of LTE and 5G, should be taken into account when defining the relevant product market.

4.2.1.1 Geographic market definition

With respect to the geographic market definitions utilised for the various relevant product markets considered in the 2014 Recommendation, merger practice confirms that almost all relevant product markets are national in scope. In so holding, the Commission has based its reasoning on mainly two decisive criteria, namely: (i) the coverage of the network infrastructure; and (ii) existing domestic regulatory instruments, such as licences that are limited to the territory of the Member State.[150]

In some Decisions, the Commission has left open the question of geographic market definition, due to the lack of competition concerns, where the definition of the relevant geographic market would not have changed the outcome of the Commission's assessment.[151] One merger control Decision briefly did consider whether the provision of TV services might have more of a regional scope rather than a national one (*i.e.*, due to linguistic commonalities, among other issues) but the Commission ultimately left the precise geographic market definition open.[152]One merger control Decision considered whether sub-national markets can be identified for retail supply of TV signal transmission, but the question has ultimately left open.[153]

As regards multi-play services, the potential for a narrower sub-national scope for the relevant geographic market has been considered (usually being associated with the limited geographic scope of many cable TV networks), but has ultimately been left open under the

149 See Case M. 7421 – *Orange / Jazztel*; Case M.7000 – *Liberty Global / Ziggo 2018*.
150 See, for example, Case M.7018 – *Telefonica Deutschland/E-PLUS*; Case M.7421 – *Orange / Jazztel*; Case M.7978 – *Vodafone / Liberty Global / Dutch JV*.
151 Examples include: Case M. 7421 – *Orange / Jazztel*; Case M.7000 – *Liberty Global / Ziggo 2018*; Case M.7758 – *Hutchison 3G Italy / Wind / JV*.
152 See Case M.7978 – *Vodafone / Liberty Global / Dutch JV*.
153 See Case M.8864 – *Vodafone/Certain Liberty Global Assets*.

Commission's merger practice.[154] As regards the wholesale market for global telecommunication services, the Commission acknowledged that the geographic scope of the market might be global in scope, while ultimately leaving the precise geographic market definition open where such a finding would have no impact on its competitive assessment.[155]

Although it begins the process of geographic definition from the assumption that markets are likely to be national in their geographic scope, the Commission's 2014 Recommendation and its regulatory practice in its "Article 7" reviews foresees the potential for geographic segmentation in appropriate circumstances, especially in the context of wholesale central access and wholesale high quality access.

It also cannot be excluded that, in the absence of linguistic barriers to take-up, the progressive elimination of practices such as roaming and call termination might have the tendency for mobile geographic markets to exhibit more regional, rather than only national, characteristics.

The Commission's merger practice has thus far taken the view that relevant geographic markets at the retail level are likely to be national in scope because, even where certain networks might only be sub-national in scope, they are quite often typified by various combinations of market actors operating across multiple geographic regions while offering services on the basis of a national strategy across the national territory, including the ability to reach customers through the use of wholesale access options.[156] As regards wholesale access markets, the Commission has relied more on the territorial scope of authorisations as the basis of the relevant geographic market. In the mobile sector, this will inevitably mean that wholesale access and roaming are national in scope,[157] although the same logic does not hold true where fixed wholesale access options might necessarily be limited to those areas where alternative network rollout has occurred, and is likely to occur.

4.2.1.2 Other trends

The assessments of relevant markets in the electronic communications sector in the various cases identified by the Study Team reflect a strong tendency towards segmentation in the

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154 Case M.7421 – *Orange / Jazztel*; Case M.7978 – *Vodafone / Liberty Global / Dutch JV*; Case M.7000 – *Liberty Global / Ziggo 2018*.

155 See, for example, Case M.8792 – *T-Mobile NL/Tele2 NL*; See also Case IV/JV.15 – *BT/AT&T*; Case COMP/M.1741 – *MCI Worldcom/Sprint*; Case COMP/M.3641 – *BT / Infonet*; Case COMP/M.6584 – *Vodafone Group / Cable & Wireless Worldwide*; Case AT.39839 – *Telefonica /Portugal Telecom*. Cases where the provision of global telecommuncations services nevertheless resulted in the market definition being let open, include Case COMP/M.3695 – *BT /Radianz*; Case COMP/M.7109 – *Deutsche Telekom / GTS*; Case M.8808 – *T-Mobile Austria / UPC Austria*.

156 See, for example, Case M.8864 - *Vodafone/Certain Liberty Global Assets*, at paras 57-61; *cf*. Case M.8808 - *T-Mobile Austria/UPC Austria*, at paras 47-55; *cf*. Case M.7231 - *Vodafone/ONO*, at paras 21-22.

157 See, for example, Case M.7758 - *Hutchison 3G Italy/Wind/JV*, at paras 178-179; *cf*. Case M.7231 - *Vodafone/ONO*, at paras 21-22 and 83; *cf*. Case M.7018 - *Telefónica Deutschland/E-Plus*, at paras 83 and 99-100; *cf*. Case M.6992 - *Hutchison 3G UK/Telefónica Ireland*, at paras 162-168.

markets for mobile telecommunications services and in relation to emerging multi-play services.

Bundled services

The emergence of a potential multi-play services market poses particular analytical challenges for the process of market definition in the electronic communications sector, especially since such converged services reflect the bridge that is being built between the respective electronic communications and media sectors, with multiple products offered across both sectors being bundled together. Until this point in time, the Commission, in its merger reviews, has left open the precise market definition for multi-play service offerings. The recurrence of the multi-play theme, however, especially given shifting consumer preferences in certain Member States, and its increasing importance in understanding the nature of market power, and the relative importance of access remedies, means that in the near future the Commission may, under its merger practice, need to provide a definitive market definition with respect to multi-play services.

Although the Commission was willing in one case to consider the extent to which the line between fixed broadband services and mobile telecommunication services might be blurring,[158] its consistent approach has been to consider such services not to be substitutable from the perspective of quality and price. With the continued expansion of LTE (and the new introduction of 5G) technology, however, it cannot be excluded that the potential substitutability of 5G and fixed broadband Internet access will need to be considered under future merger review analyses.

Customer segmentation

Finally, the often-occurring assessment of a potential segmentation between private and business customers, and even sub-segments thereof, in the retail market for mobile telecommunication services, suggests that the particular ways in which services and products are offered may soon no longer be the sole basis upon which they are not deemed to be substitutable. As the precedents stand, however, there is a general reluctance for clear demarcation lines to be drawn between business and private users.

4.2.1.3 *Collective SMP and multi-product retail markets*

The existence of widely drawn retail product markets made up of bundled service offerings in highly concentrated markets also raises questions for those NRAs wishing to base their asymmetric regulatory measures on the existence of a position of collective dominance (collective SMP). This is illustrated in the recent annulment of the measures introduced by

158 See Case M.8808 - *T-Mobile Austria/UPC Austria*.

the Netherlands' ACM on the basis of a collective SMP finding with respect to wholesale broadband access.

In March 2020, an Appeals Tribunal annulled in its entirety the Decision of the ACM in 2018 to impose wholesale access obligations on KPN and VodafoneZiggo,[159] based on those parties' position of collective SMP in the retail market for bundled telecommunications services that included Internet access. In the eyes of the Tribunal, the ACM had failed to satisfy the standard of proof required of it under the various criteria set forth in the *Airtours Judgment*.[160] According to the Tribunal, this failure was linked to the ACM's misapplication of the so-called Modified Greenfield Analysis approach set forth in Recital 17 of the *SMP Guidelines*,[161] by not taking due account of existing market conditions shaping access relationships in the sector, especially in the shadow of threatened regulatory intervention.[162] Understanding the genesis and content of those existing access relationships was, in the eyes of the Tribunal, essential in determining the likelihood of the parties adhering to tacitly collusive outcomes.

Importantly, the Tribunal found that the ACM had erred in its collective SMP finding because the critical elements of sufficient symmetry in the retail market conditions experienced by the parties, transparency in their commercial offerings and dealings with one another, and the existence of realistic retaliatory measures, were not proven on the facts of the case by the ACM.[163] Much of the underlying logic behind the Tribunal's Ruling is consistent with the understanding that these three critical lines of enquiry under the *Airtours* test (namely, the existence of market symmetries, conditions of market transparency and the possibility of market retaliation) were exceedingly difficult to satisfy if the retail market were to be drawn very widely because it is made up of bundled service offerings.[164]

Ultimately, having found that the ACM was wrong in its application of the collective SMP test, the Tribunal declined to express a view on the precise scope of the retail market definition constituted by services bundles which included Internet access, which had been relied on by the ACM as it was not necessary for the Tribunal to do so in light of its primary finding on the lack of collective SMP.

The Dutch Tribunal's Ruling is important for a number of reasons. *First*, it demonstrates that a finding of collective SMP will be fraught with difficulties of application if the focal point of the parties' tacit collusion is going to take place in retail markets that consist of widely drawn

159 Judgment of the Dutch Trade & Industry Appeals Tribunal (CBd) of 17 March, *KPN and VodafoneZiggo et al. v. Netherlands Authority for Consumers and Markets*, ECLI:NL:CBB/2020:117.

160 Judgment of the Court of First Instance of 6 June 2002, Case T-342/99, *Airtours plc v Commission*, ECLI:EU:T:2002:146.

161 Communication from the Commission — Guidelines on market analysis and the assessment of significant market power under the EU regulatory framework for electronic communications networks and services, C/2018/2374, OJ C 159, 7.5.2018, p. 1–15.

162 Judgment at paras 5.1-5.6.

163 Judgment esp. at para. 6.3.

164 In other words, the greater the range of products, prices and different pricing strategies, the more complex the nature of the interactions required to sustain a situation of tacit collusion and the more difficult if would be for the parties to exert meaningful retaliatory measures against one another to enforce that tacit collusion.

service bundles, as the fulfilment of the *Airtours* criteria in such circumstances will not be straightforward. *Second*, it emphasises the complexities of applying a Modified Greenfield Analysis in a collective SMP scenario. *Third*, it demonstrates that, whereas the Tribunal was willing to follow statements made in the *SMP Guidelines* that addressed a general policy issue such as the Modified Greenfield Analysis, it was reluctant to depart from European case-law when applying a collective dominance test in the context of electronic communications, even though the revisions to the *SMP Guidelines* in 2018 arguably introduced a more structural approach towards collective SMP assessment in the electronic communications sector.

However, before one can conclude that that the 2018 revisions to the *SMP Guidelines* have not shifted the nature of the analytical enquiry into collective SMP into an approach which is as much focused on industry structure as it is on actual market behaviour, it needs to be borne in mind that: (1) the ACM exercises competition law powers in parallel with its regulatory powers and, as such, it was only logical for the Tribunal to conclude that its application of a collective SMP test should satisfy the strict competition law standard of proof established under *Airtours*; (2) one of the putative members of the collective dominant position, VodafoneZiggo, had only recently been the subject of a merger between two operators from the respective mobile and cable sectors, which meant that conclusions drawn about likely future behaviour over the next three years would inevitably not be based on a firm understanding of current commercial policies *vis à vis* KPN, but would be highly abstract in nature; and (3) the Tribunal could rely on the game theory model provided by an external economic study submitted by one of the parties in support of the proposition that tacit collusion was unlikely in relation to the grant of access, whereas the ACM could not support its hypothesis by a comparably persuasive economic model.

By contrast, the approach taken by the Belgian NRA, the CRC (which includes the BIPT), varies significantly when compared to that of the ACM. Instead of focusing on an approach based on the establishment of collective SMP derived from multi-product retail markets, the CRC opted to define distinct wholesale broadband access markets by reference to the different technical standards used for respectively wholesale access over a telecommunication network and a cable-TV network. In doing so, the CRC was able to avoid the dilemma faced by its Dutch counterpart, as the breadth of the relevant retail market was irrelevant in deterring two different instances of individual SMP held for wholesale broadband access.[165]

165 The distinction between central access under ITU SG15 standardisation and central access under CableLabs standardisation is due to the use of different protocols used. These protocols lead to the absence of substitutability between both products. On the demand side, the migration between products under different types of standardisation generates considerable costs and delays. On the supply side, the provider of a wholesale access to broadband under a particular type of standardisation would not be able to adapt their means of production without facing considerable costs and delays. There is also no sufficient indirect constraint to justify the fact of joining these two products together in the same market" (BIPT, Decision of 29 June 2018, Analyse van de markten voor breedband en televisieomroep, Englisch summary, p. 11-12, available at https://www.bipt.be/public/files/nl/22533/Besluit_Analyse_markten_breedband_televisieomroep.PDF).

4.2.1.4 Conclusions

The process of market definition by NRAs under the 2014 Recommendation and the Commission's merger practice under the EUMR reflects a fundamentally similar approach, even though merger market definitions can by and large be more granular and the Commission is not obliged to take definitive positions on market definition issues unless such a finding is material to its overall competitive assessment of the notified merger. Under both regulatory and merger scenarios, the Commission takes into consideration both a supply-side perspective and the usual demand-side perspective in relation to each relevant market, although merger practice is much more likely to entertain the possibility of greater market segmentation than its regulatory counterpart. On balance, however, arguably the strongest analytical trend is the tendency of the merger review process to embrace relevant market definitions in the electronic communications sector on the basis of a supply-side approach – something that is usually associated with the regulatory tradition.

The analytical basis for defining sub-national markets for wholesale access is in principle no different under a merger analysis when compared to one performed under *ex ante* regulation, especially when one considers that merger analysis has a strong *ex ante* component. However, the apparent greater willingness of a regulatory analysis to identify sub-national markets can probably be explained by the simple fact that the primary remedy available to NRAs in an SMP setting is a behavioural access remedy which needs to be overseen by the NRA over a number of years, and which will often be subject to dispute settlement and revision overseen by the NRA. By contrast, the merger regime will always defer towards remedies which are structural in character, and will often determine that intervention might be unnecessary precisely because regulation already addresses some or all of the potential market failures identified in a post-merger setting. In such circumstances, it has been largely unnecessary for a merger analysis to need to have such a level of granularity as regards the issue of geographic market definition.

4.2.2 Abuse of Dominance

In reviewing the approach to market definition which the Commission has adopted in Decisions relating to abuse of dominance cases, the Study Team has examined six key Article 102 TFEU cases,[166] which have been adopted both before and after the publication of the Relevant Markets Recommendation of 2014.

166 These cases are: *Deutsche Telekom*, Commission Decision (Case COMP 37.451, 37.578, 37.579), Case T-271/03 [2008], Case C-280/08 P [2010]; *Téléfonica*, Commission Decision (Case COMP/38784) Case T-398/07, *Spain v. Commission*; actions brought 10 September 2007 (C269/55) and 31 October 2007 (C8/17); appeals from Commission Decision COMP/38.784 – *Téléfonica*, OJ 2008, C8315; Case T-336/07, *Téléfonica and Téléfonica de España v. Commission*, Judgment of 29 March 2012 (ECLI:EU:T:2012:172); Decision 2012/C 138/22 (29 March 2012); Case C-295/12 P *Téléfonica v Commission* (ECLI:EU:C:2014:2062); *Wanadoo Interactive*, Case COMP/38.233; CFI Case T-340/03 (16 January 2007) (ECLI:EU:T:2007:22); ECJ Case C-202/07 (2 April 2009); Case C-52/09, *Konkurrensverket v TeliaSonera AB*) (2.04.2011); Judgment of 17 February 2011 (ECLI:EU:C:2010:483); Case COMP/39.525, The technological landscape in the telecommunications sector in the period leading to 2014 differed to a significant extent from the capabilities available today, which in general has led to a smaller number of relevant markets being assessed than appeared in the original Commission Relevant Market Recommendation or in the merger control review decisions discussed. The Study Team has focused on a total of six different product markets that the Commission has identified in relation to abuse of dominance findings. This figure, when compared to the much larger number of identified potential product markets under a merger analysis, can be explained by virtue of the fact that the Commission is required to examine a much wider range of markets in a merger analysis, especially by contrast to the very focused nature of a complaint lodged under Article 102 TFEU, built upon existing historical fact pattern. Of the six product markets involved, two are wholesale markets and four are retail markets. The product markets that have been identified in the six abuse of dominance Decisions concern exclusively data-related services rather than voice services, in particular fixed access-related services to telecommunications networks.

At the wholesale level, the Commission in its assessment has defined a market for wholesale fixed network/broadband access, and a wholesale market for fixed (physical) network infrastructure access.[167] At the retail level, the Commission has identified a retail market for fixed narrowband, a retail fixed broadband market for tailor-made solutions for large corporations, a retail market for broadband Internet access for residential customers, and a retail broadband Internet access for business customers. The approach which the Commission has taken in relation to the defined wholesale markets in the six abuse of dominance cases examined is also largely reflected in the 2014 revised Commission Relevant Market Recommendation.

More specifically, the following lessons can be drawn for the Relevant Market Recommendation from abuse of dominance cases.

A. Fixed network access wholesale markets

The relevant wholesale markets which the Commission has assessed in its administrative practice include a market for wholesale fixed network/broadband access, and a wholesale

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Telekomunikacja Polska, Commission Decision of 22 June 2011; Case T-486/11, Judgment of 17 December 2015 (ECLI:EU:T:2015:1002); Case C-123/16, Appeal of 27 February 2016; *Slovak Telekom*, Case AT.39523, Commission Decision C(2014) 7465 final of 15 October 2014; Case T-851/14, Judgment of the General Court of 13 December 2018

167 See, for example: *Deutsche Telekom*, Commission Decision (Case COMP 37.451, 37.578, 37.579), Case T-271/03 [2008], Case C-280/08 P [2010]; *Téléfonica*, Commission Decision (Case COMP/38784), Case T-398/07, *Spain v. Commission*; actions brought 10 September 2007 (C269/55) and 31 October 2007 (C8/17); appeals from Commission Decision COMP/38.784 – *Téléfonica*, OJ 2008, C8315; Case T-336/07, *Téléfonica and Téléfonica de España v. Commission*, Judgment of 29 March 2012 (ECLI:EU:T:2012:172); Decision 2012/C 138/22 (29 March 2012); Case C-295/12 P *Téléfonica v Commission* (ECLI:EU:C:2014:2062); Case COMP/39.525, *Telekomunikacja Polska*, Commission Decision of 22 June 2011; Case T-486/11, Judgment of 17 December 2015 (ECLI:EU:T:2015:1002); Case C-123/16, Appeal of 27 February 2016; *Slovak Telekom*, Case AT.39523, Commission Decision C(2014) 7465 final of 15 October 2014; Case T-851/14, Judgment of the General Court of 13 December 2018, (ECLI:EU:T:2018:929); Appeal rejected on 18 March 2019, (ECLI:EU:T:2019:182).

market for fixed (physical) network infrastructure access. Those two wholesale markets correspond to the wholesale markets listed in the Recommendation for local Internet access at a fixed location ("WLA") for specific customers and to the wholesale central Internet access market at a fixed location ("WCA"). In its assessment of the relevant product markets in the various abuse of dominance cases, the Commission has differentiated those general wholesale fixed broadband services that allow retailers to provide network access to end customers and has considered the various different technologies used to deliver such services such as ISDN and xDSL.[168] The same approach is used by the Commission in its 2014 Recommendation.

As has occurred in its regulatory assessment, the Commission in the abuse of dominance cases also identifies specific sets of customers that utilise predominantly fully or shared local loop unbundling, on the one hand, and mere access to broadband infrastructure, on the other. In its 2014 Recommendation, however, the Commission considered a greater variety of technologies, such as Bitstream, virtual access and dedicated connections, which have not as yet been assessed in the cases adopted under Article 102 TFEU. This can be in part explained by the technological progress which the electronic communications sector had made in the years immediately prior to the adoption of the 2014 Recommendation, and which has gathered pace since then.

B. Fixed network access retail markets

In the Commission's assessment of data-related retail markets, the focus has been on the retail mass market for access to data and on the retail high-quality market for access to data at a fixed location. The approach which the Commission has adopted in its abuse of dominance case practice is consistent with the two retail markets that appear in the 2014 Recommendation.

However, in contrast to the regulatory assessment for the retail mass market for access to data, the Commission in its 102 TFEU case practice has arrived at slightly different conclusions. In one case, the Commission considers that the retail market for access to data should be segmented into two separate markets, namely, a retail market for access to data for residential customers and a separate market for business customers. The justification for this segmentation is said to lie in the different price ranges available for the products, the superior operating capacities of business customers and the wider range of technical options for access, such as through leased lines, wireless local loop or satellite transmission that are available to business customers.

168 This does not mean, however, that the Commission will not limit its analysis to one particular form of technology where other technological substitutes are not really available: refer to *Telekomunikacja Polska*, Commission Decision of 22 June 2011; Case T-486/11, Judgment of 17 December 2015 (ECLI:EU:T:2015:1002); Case C-123/16, Appeal of 27 February 2016] at paras. 579- 625.

In another case,[169] however, the Commission concluded that there was only one general retail mass market for broadband/data access. Having considered the characteristics of usage, speed, type of technology, price, and presence of individual specificities of the services, the Commission came to the conclusion in that case that there is a general retail market for broadband/data access for both residential and non-residential customers. In the same decision, the Commission excluded from the relevant market definition tailor-made solutions for large corporations.

This suggests that before the adoption of the 2014 Commission Recommendation, the Commission encountered practical difficulties in clearly differentiating between residential from business customers and, in turn, large corporations for market definition purposes. It can, however, be assumed, when considering the services used by business customers, that the Commission, in the case where it differentiated between residential customers and business customers, implicitly intended to exclude large corporations from that category, as it had done in relation to the retail market for tailor-made solutions for large corporations. The services used by customers in the retail market for broadband/data access for tailor-made solutions, which include delivery through leased lines, wireless local loop or satellite transmissions, reflect the services that are provided in the retail high-quality data access market, as listed in the 2014 Commission Recommendation. Thus, it is arguable that the retail access to broadband/data market for some business customers would fall within the high-quality retail data access market, although it may well be the case that some businesses are satisfied to use mass-market solutions (instead of using leased lines, for example).

The retail markets for fixed narrowband access that the Commission has identified in its older case practice was a market that concerned relatively low Internet speeds, albeit with increased quality and security aspects. As broadband deployment has become more widespread over the years and as retail customers have embraced broadband services, there is now a clear divide between narrowband and broadband access.[170]

4.2.2.1 Geographic market definition

The geographic market definitions that the Commission relied upon in its abuse of dominance case practice and the approach taken under the 2014 Commission Recommendation are largely similar. The general geographic scope for the wholesale market level and the retail market level has consistently been assessed to be national. In doing so, the Commission has attributed prominence to two particular elements, namely: on the one hand, the territorial coverage of the respective network infrastructures; and, on the

169 See Case COMP/39.525, *Telekomunikacja Polska*, *supra*.

170 As reflected in the Commission's Decision in *Slovak Telekom*, Case AT.39523, Commission Decision C(2014) 7465 final of 15 October 2014 other, the domestic regulatory instruments that are in place which affect the commercial performance of the undertakings in question.[171]

Only in one case did the Commission consider in detail the possibility of a division of the geographic scope into territorial sub-levels, based on the existence of parallel networks.[172] The Commission, however, ultimately concluded that, on the particular facts of that case, the constraints created by the wholesale market were insufficient in order to justify a segregation of the geographic market. Moreover, pricing differences have not played a significant role in geographic market analysis, given the longstanding process of PSTN incumbent operators to charge geographically de-averaged prices.

Under its regulatory approach, however, the Commission acknowledges that the NRAs should assess whether the scope of the relevant geographic market can be different in the future for individual product markets.

4.2.2.2 Conclusions

The identification of product markets by the Commission in its abuse of dominance case practice has been for the most part reflected in the revised 2014 Relevant Market Recommendation. The main differences in the assessment are attributable to the ways in which changes in technology have been interpreted and the increasing awareness of a changing product spectrum for residential and non-residential customers. Having said that, a more expansive view has been taken under the regulatory approach by including a broader scope of existing and developing technologies. This is the natural by-product of a regulatory approach which is forward-looking and supply-side oriented, as the competition level approach looks backward to historical abusive practices and is limited to the particular form of access requested (*i.e.*, a demand side analysis) at the time of the allegedly abusive

171 See, for example: *Deutsche Telekom*, Commission Decision (Case COMP 37.451, 37.578, 37.579), Case T-271/03 [2008], Case C-280/08 P [2010]; *Téléfonica*, Commission Decision (Case COMP/38784), Case T-398/07, Spain v. Commission; actions brought 10 September 2007 (C269/55) and 31 October 2007 (C8/17); appeals from Commission Decision COMP/38.784 – Téléfonica, OJ 2008, C8315; Case T-336/07, Téléfonica and Téléfonica de España v. Commission, Judgment of 29 March 2012 (ECLI:EU:T:2012:172); Decision 2012/C 138/22 (29 March 2012); Case C-295/12 P Téléfonica v Commission (ECLI:EU:C:2014:2062); Case COMP/39.525, *Telekomunikacja Polska*, Commission Decision of 22 June 2011; Case T-486/11, Judgment of 17 December 2015 (ECLI:EU:T:2015:1002); Case C-123/16, Appeal of 27 February 2016.

172 See *Slovak Telekom*, Case AT.39523, *op. cit.*; Case T-851/14, Judgment of the General Court of 13 December 2018, (ECLI:EU:T:2018:929). Appeal rejected on 18 March 2019, (ECLI:EU:T:2019:182), Slovak Telekom considered that three different clusters of local markets could be identified as follows: two clusters where ST's retail market share was below [35%-45%]: with Cluster A1 consisting of [40%- 50%] of Slovak households where there was strong facility-based competition and where ST's retail market share in all broadband services (including mobile) was [20- 30%] and [20%-30%] if only fixed broadband services were included (this cluster included in essence the larger cities of the Slovak Republic and a number of smaller cities where ST's market share was less than [35%-45%]); Cluster A2, accounting for [10%-20%] of Slovak households and covering rural areas where ST's retail market share in all broadband services (including mobile broadband) was [30%-40%] if only fixed broadband services were to be included. Cluster B accounted for [35%-45%] of Slovak households and consisted of areas where ST's retail market share in all broadband connections (including mobile broadband) was [60%-70%], if only fixed broadband connections were to be taken into account.

behaviour. In these circumstances, it should not be surprising that the approach taken under the Article 102 TFEU precedents may be narrower than their regulatory counterparts.

4.2.3 State Aid Practice

While it may be the case that State aid practices focuses on the identification of “target areas” rather than markets, it is also the case that the support of local broadband networks with State aid, given that the aid is conditioned by open access obligations, means that there will often be situations where local competitive conditions in such regions are very different to those regions where broadband rollout has proceeded without State aid assistance. In these situations, there is a much higher likelihood of sub-national markets being identified. Because of the different patterns of wholesale access availability between regions, especially as the roll-out of such networks becomes more prevalent. Insofar as the PSTN incumbent in a given geographic area is obliged to grant access, for example, while another State-sponsored network is also obliged (as a condition of its financial aid) to grant access, this area might be significantly differentiated from other neighbouring geographic areas both with respect to the number of available access options and the ensuing retail pricing that might follow as a result of such readily available access at the wholesale level.[173]

One of the major policy changes introduced by the 2013 revisions to the *Broadband Guidelines* related to the requirement that State aids for new network deployment should apply only to those investments in infrastructure which constituted a ‘step change’ in performance as regards what was already in place before the investment took place.[174] The idea is that a ‘step change’ will be reflected in a significant incremental network investment which leads to significant new capabilities in terms of speed and capacity and availability. This clearly includes fibre to the home or to the premises, which is consistent with the view that State aids support should be limited to these more ambitious and risky investments.[175]

173 Further discussion of State Aid practices, including access regulation in this context is contained in an ongoing study by WIK, LE Europe et al. on the Implementation of the Broadband State Aid Guidelines. The current discrepancy between market review measures being only of three years’ duration, while access obligations are imposed over a much longer period of usually seven years as a condition to receiving State aids, is being narrowed as a result of the relevant review period under the Code now being set at five years.

174 See Recital 51.

175 See Recital 58. The appropriate levels of capacity could be delivered by FTTX networks, advanced wireless networks and by cable networks upgraded to the DOCSIS.3.0 standard. Wholesale-only providers would arguably be able to obtain State aids to roll out such networks on an exceptional basis even in a “black NGA area”. As to the less onerous regulatory obligations on wholesale-only providers, refer also to Article 80 *EECC*. As to the importance of very high capacity network elements, refer to Article 76 *EECC*. It is not anticipated that the “step change” criterion used in State aids practice will result in fundamentally different technological capabilities when compared with other networks, especially given the impetus under the Code in supporting the rollout-out of Very High Capacity Networks.

5 Markets associated with broadband access and high-quality access

In this chapter, we assess whether the boundaries between markets relating to broadband and business access should be redefined and if any of the markets identified should still be susceptible to ex ante regulation.

In doing so, we follow the approach outlined in the SMP Guidelines, and take into account technological and market developments which may shape business and broadband markets in the coming years, such as the evolving demands of residential and business customers as well as connectivity needs for the expanding M2M/IOT market, the progressive deployment of FTTH and evolution in wireless technologies, as well as the emergence of new business models and co-operative agreements in several EU member states. We also take into account the three criteria test as established in the context of the EU Electronic Communications Code.

The chapter is structured as follows:

- In section 5.1, we consider the scope of the relevant retail market(s) associated with broadband access and whether they tend towards competition. Questions include whether business access should be considered in the same relevant market as access provided to residential and small business customers, whether the market should be segmented by technology or speed, whether mobile and wireless technologies should be considered to be in the relevant market and whether bundled markets could be identified.
- In section 5.2, we consider the scope of the relevant wholesale market(s) associated with broadband and whether they meet the 3 criteria test. We specifically consider in this context the treatment of ducts and poles, and whether it should be considered as a separate market, whether there should be a single broadband market encompassing local and regional connectivity, whether cable, mobile and wireless access should be considered to be in the relevant market, and how dedicated symmetric connections for business, fixed and mobile backhaul should be treated.

We also consider, in the context of each market, to what extent geographic segmentation of the market and/or remedies may be relevant.

5.1 Relevant retail markets

5.1.1 Regulatory practice concerning the definition of retail broadband and business markets in the EU

The chart overleaf provides an overview, based on a review of the EC's Article 7 notices, of how retail markets associated with the wholesale markets for mass-market and high-quality data provision 3a, 3b and 4 have been defined across a range of European countries under the EU Framework for electronic communications.

Common themes are that:

- Although markets 3a and b are commonly associated with mass-market broadband – i.e. broadband targeted towards consumers and small businesses, some countries have **included the provision of services to larger businesses** within the scope of the associated retail markets. A key reason for this approach has been that some products within the market – notably copper LLU and, in some cases duct and pole access and physical fibre access, may be used for business purposes when coupled with appropriate SLAs.

- Despite the proposal to widen the scope of the market for „high quality„ access to include business-grade bitstream in the context of the 2014 Relevant Market Recommendation, some countries have continued to focus their analysis in this market on dedicated business infrastructure

- In nearly all cases, NRAs have defined retail markets in a manner which is technologically neutral. However, in a recent draft Decision, Sweden is proposing to make a **distinction between copper and very high capacity technologies** (cable and fibre) in their definition of the market and associated analysis.

- Segmentation on the basis of speed is not typically pursued in retail markets linked to mass market broadband. However, some countries have segmented high quality (business) retail markets by speed on the basis that the competitive conditions vary.

Although not included in the table below, it is worth noting that most NRAs have concluded that **mobile and wireless technologies do not substitute for fixed broadband retail access**. However, such substitution was found between 2013-2017 in Austria, while Croatia recently concluded that hybrid broadband access (combining fixed and wireless technologies) provided a substitute in some cases. Wireless technologies have also been considered to be included in the retail market in the Czech Republic, due to the prevalence of WiFi connections.

In the following sections, we consider each of these potential scenarios with a view to drawing conclusions about whether the developments identified in some countries may have wider relevance across Europe.

Table 5-1: Approaches to retail market definition in the WLA, WCA and HQA markets

3a NGA review 2016-2019		Austria	Belgium	Bulgaria	Croatia	Czech	France	Denmark	Germany	Greece	Poland	Italy	Portugal	Spain	Sweden	UK
Market 3a (ex 4)		2017	2018	2019	2019	2017/18	2017	2017	2015	2016	2019	2019	2017	2016	2019 (dr)	2018
Retail market	Includes larger businesses [y/n]?	Y	Y	N	N	N	Y	N	N	N	N	N	N	N	N	Y
	Segmented by technology [y/n]?	N	N	N	N	N		N	N	N	N	N	N	N	Y (c/f)	N
	Segmented by speed [y/n]?	N	N	N	N	N	Y	N	N	N	N	N	N	N	60MBit/s	N
3b NGA review 2016-2019		Austria	Belgium	Bulgaria	Croatia	Czech	France	Denmark	Germany	Greece	Poland	Italy	Portugal	Spain	Sweden	UK
Market 3b (ex market 5)		2017	2018	2015	2019	2017/18	2017	2017	2015	2016	2019	2019	2016	2016	2015	2018
Retail market	Includes larger businesses [y/n]?	Y	Y	N		N	Y	N	Y	N	N	N		N	N	N
	Segmented by technology [y/n]?	N	Y	Y	N	N	N	N	N	N	N	N		N	N	N
	Segmented by speed [y/n]?	N	N	N	N	N	N	N	N	N	N	N		N	N	N

Market 4 review 2014-2019		Austria	Belgium	Bulgaria	Croatia	Czech	France	Denmark	Germany	Greece	Poland	Italy	Portugal	Spain	Sweden	UK
		2018	2013	2016		2017	2017	2016	2016		2015	2015	2016	2016	2016	2019
Combined with M3a/3b review? [y/n]		Y					Y	N	N			N	N	Y	N	N
Retail market	Includes business "bitstream" [y/n]?	N	N	N			Y	N	N			N	N	N	Y	N
	Segmented by technology	N	N	N		N	N	N	N			N	N	N	N	N
	Segmented by speed	Y	N	N		Y	N	N	Y			N		N	N	N

5.1.2 Is retail mass-market data connectivity in the same relevant market as business-grade connectivity?

High-end users of connectivity have typically demanded a number of features that were not available to end-users of mass-market broadband connectivity. These include:[176]

- High and symmetric bandwidths
- Dedicated capacity[177]
- High quality of service metrics including low latency, jitter and packet loss
- High levels of reliability; and
- Redundant connections to ensure alternatives are available in case of failure

In addition, business users often require service levels, and in particular repair times and 24x7 service desks, that are more advanced than those available to consumers.

These requirements have been based on business' needs for two-way connectivity, for example for cloud usage and video conferencing, simultaneous accesses by multiple users, and a requirement to maintain services continuously.

In the explanatory memorandum accompanying the 2014 Recommendation on Relevant Markets, the Commission noted that "*many business customers need more advanced and reliable services to link their business units and locations and allow for internal communication… As a result, a standardised, mass-market retail broadband product would usually not meet such requirements, even though some businesses would find their needs satisfied with such a product or would occasionally complement a high-quality product with mass-market offering*s." The Commission also noted that large businesses often preferred to purchase different services from a single supplier covering multiple sites.[178]

On this basis, the Commission concluded that there was a separate retail high-quality market which included a variety of products that are geared towards the specific needs of these individual customers. "*A high quality of service level, and guaranteed availability, sufficiently high upload and download rates, limited contention and range, for example, are important characteristics of these retail products*."

176 See the WIK (2015a).
177 Dedicated capacity provides unshared capacity which only is available to the business connection, not overbooked or shared by other users. It is comparable to a leased line, and can be defined independently of the physical medium, which was previously reliant on copper, and is now more typically fibre-based end to end. The dedicated capacity for high-end users can be a subset of the access lines' capacity, but cannot exceed it (considering both ends). Dedicated capacity will be guaranteed by the connection providers.
178 See page 36 Explanatory memorandum accompanying 2014 Relevant Market Recommendation.

Looking beyond 2014, usage of cloud and unified communications (involving video and file sharing) by businesses has increased over time, rendering high-grade connectivity requirements even more important for businesses.[179] In addition, more smaller businesses have taken up use of digital platforms,[180] expanding the needs for "high-quality" communications beyond the larger businesses that previously used such services.

Industrial reliance on connectivity is set to increase further with the addition "smart" applications supported by M2M and IOT e.g. in the fields of smart agriculture, transportation, health, education etc.[181] These new applications often require additional wireless or mobile connectivity to be provided, and will likely in the coming years require dedicated fixed connectivity to key sites coupled with 5G.

The development of big data analytics, requiring two-way access to high performance computing facilities, is also likely to require dedicated connections, with some links needing terabit connectivity to support real-time processing of data by HPCs.[182]

The association representing international business users of telecommunications confirms that larger business needs are now increasingly complex and bespoke,[183] and can involve the provision (often by systems integrators rather than necessarily communications providers) of bundles of fixed and mobile communications services coupled with IT solutions, which may cover multiple sites (potentially in multiple countries), remote workers and IOT systems.

This would tend to provide evidence that on the demand side, the needs of large businesses are distinct from the standardized communications services that may be purchased by consumers or small single site businesses. Differences include the manner in which services are bundled, the "multi-site" nature of service requirements, and – for some applications – the need for dedicated fibre-based capacity.

At the same time, however, demands of consumers are evolving towards more high capacity solutions. Developments in high definition video alongside the use of cloud services and storage, the popularity of OTT video communications and proliferation of home devices also point to demands for higher bandwidth and symmetric connectivity for consumers. Bandwidth demands and requirements for low latency for home broadband are also likely to be driven by AR and VR applications which are beginning to become popularized in the context of gaming, but may also play a role in other fields such as education and training.[184]

179 See for example the results of survey data reported in Flexera (2019) Rightscale State of the Cloud Report, as well as eurostat data on the use of cloud computing and big data https://ec.europa.eu/eurostat/documents/2995521/9447642/9-13122018-BP-EN.pdf/731844ac-86ad-4095-b188-e03f9f713235
180 Mordor Intelligence (2020).
181 Case studies on smart applications and the implications for corporate connectivity needs are included in a WIK (2019g).
182 See European Commission (2020c).
183 Interview with INTUG 6 Nov 2019.
184 See case studies in WIK (2018a).

Thus, the distinction between the connectivity requirements of larger businesses and consumers may diminish, although there are likely to remain gaps in the scale of bandwidth required and the need for reliability, redundancy and high service levels.

Moreover, access technologies developed for the mass market are becoming increasingly capable of meeting the requirements of business customers. This is evidenced by the increasing use of mass-market technologies including FTTC, FTTH and cable connections for business purposes. Of those NRAs which provided disaggregated data on business markets for this study[185], in many cases a high proportion of "high quality" lines provided to businesses have been offered via "mass-market" broadband technologies, including FTTH/B, FTTC and cable, while the number of symmetric dedicated connections for business (leased lines provided via point to point FTTP or copper) has remained stable or in some cases (especially for copper) has been in decline.[186]

A number of respondents to the European Commission's public consultation, primarily incumbent operators and specialist providers of business connectivity, also highlighted trends towards an increasing reliance by businesses on mass-market broadband infrastructure.[187]

Further evolutions in FTTH technology and support for symmetry and reduced latency (see section 2.6.7), alongside the increasing availability of FTTH in the coming decade are likely to increase the scope for mass-market solutions to be used for businesses, in cases where only dedicated fibre connections may have sufficed, or were available in the past.

That said, as indicated in the technological analysis (see section 2.6.3), significant performance gaps are likely to remain between shared and dedicated point to point FTTH solutions, and some business connectivity needs (including connectivity in conjunction with private 5G networks, connections to data centres,) are likely to require dedicated fibre connectivity, while it is desirable for connections to schools, hospitals and other socio-economic drivers to be capable of supporting advanced "smart" applications and the exchange of data and video communications that may be available in the coming decade.

For use cases where dedicated connectivity is required or is desirable for the achievement of the Gigabit Society goals (and its successor), it is not clear that mass-market solutions would provide a pricing constraint, since business or public users or their service suppliers would not be able to switch to mass-market connectivity in response to a price increase (or would be constrained in the event of this switch), although users of mass-market connectivity might "upgrade" if the pricing differential narrowed.

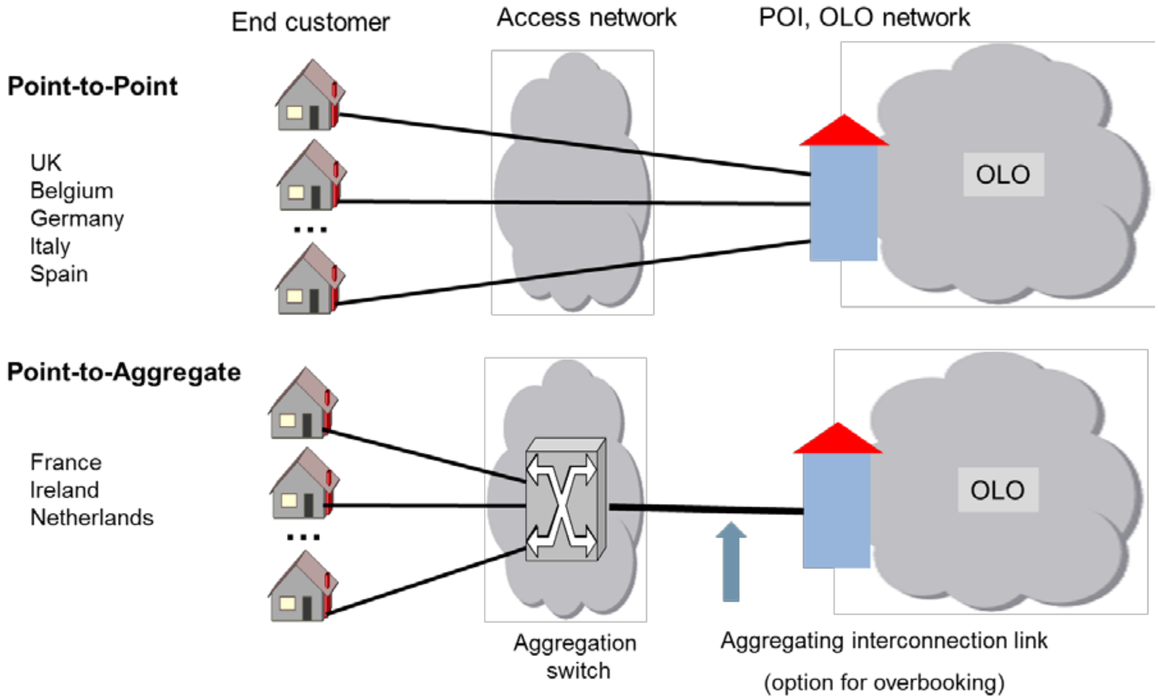
185 NRA survey, data gathered in October 2019. Data received from 7 EU countries.

186 Dedicated leased lines form as little as 4% of total business access lines in 2 of countries reporting data, and lies around or below 25% in the others. Higher shares were reported in Slovenia, which is characterised by the deployment of point to point fibre rendering dedicated business connections for the mass-market as well as to businesses. There was also a high proportion of dedicated business connections in Hungary, but the absolute number and proportion has been in decline.

187 For example, ETNO and PT.

From the demand side, this would tend towards a segmentation between dedicated fibre connectivity for business use on the one hand, and connectivity provided by means of a shared connection to residential and business users. As shown in Figure 2-9, the distinction in performance is greatest when comparing point to point fibre with services based on a shared PON architecture. This supports a potential demand-side segmentation between shared and dedicated infrastructure. Dedicated connections/leased lines are in general based on a point to point fibre connection, at least in the access network. However, in some countries such as France, Ireland and the Netherlands,[188] point to aggregate leased lines are commonly offered, whereby traffic is collected at an aggregation switch, and transmitted over an interconnection link which provides scope for overbooking (see following figure). In these cases, the physical link may not be "dedicated" across the whole path, but may still be distinguished from residential offers, when the service provider is offering "guaranteed" bandwidth, with very stringent quality of service parameters and service level guarantees. Especially when there is limited or no overbooking provided for, point to aggregate leased lines may substitute for point to point leased lines.

Figure 5-1: Ethernet leased line architectures



Source: WIK-Consult

Alongside demand-side substitution, it is necessary to consider the potential for entry into this segment (supply-side substitution) as this could also influence whether separate mass-market shared and dedicated or guaranteed access market segments should be identified.

188 See Annex III in WIK (2014).

A key question in this regard is whether “mass-market” broadband providers would be readily able to enter this market segment. In locations where there are alternative infrastructure-based operators with their own ducts including cable operators and alternative fibre investors, there may be scope for these providers to make use of their ducts to provide dedicated services to businesses. For example, dedicated leased line connections are available from companies such as Virgin Media[189] in the UK, even though the core business of the company relates to mass-market services. Likewise, companies such as Vodafone, which is building up its own business service segment and has infrastructure in several European markets, offers dedicated capacity to businesses alongside incumbents and traditional business access specialists such as Colt and Verizon Business.[190] In countries in which mass-market FTTH deployment is widespread, alternative operators with their own FTTH infrastructure are also making available offers to businesses, with options for shared or dedicated capacity.[191]

Meanwhile, companies which have deployed point to point FTTH connectivity such as municipal networks and the incumbent in Sweden and the incumbent in KPN (through the Reggefiber network), have used the same network for business and residential connectivity.[192]

On the face of it, these developments might suggest that dedicated and shared capacity may be in the same relevant market due to supply-side constraints. However, there are a number of distinctions, which mean that separate consideration of these segments may be warranted.

Firstly, the degree of (and locations for) competition in dedicated access may differ from that for shared (mass-market) access, at least prior to the widespread deployment of FTTH. Business districts may be served by specialist business access providers such as COLT, Verizon Business, Eurofiber etc., which are not present in residential areas (and vice versa). The high value nature of business services has also meant (e.g. in countries such as Ireland, Austria and the UK) that certain districts have become competitive for dedicated access, while they are not (yet) and may not become competitive as regards very high capacity connectivity to the mass-market. There may also be more remote geographic areas where FTTH has not been deployed (and may not be viable in the long term), but where there remains demand for dedicated connectivity (e.g. from public institutions), with limited potential for competitive supply.

Another important difference, which is referenced in the explanatory memorandum to the 2014 Recommendation on Relevant Markets,[193] and has been highlighted in countries such

189 Virgin Media (2020).
190 Vodafone (2020a).
191 See for example SFR Business, which offers “mutualised” fibre, with bandwidths of up to 1Gbit/s as well as “dedicated” fibre (fibre which involves no sharing of bandwidth), which is available at guaranteed bandwidths with symmetric bandwidths from 4Mbit/s to 1Gbit/s,
192 See WIK (2018b).
193 Paragraph 4.2.1

as Spain[194] as well as studies conducted by WIK[195] is that, in contrast with consumer and small business demand, high end business demand is often multi-site or even multi-national. Because competition for contracts requires competitors to connect multiple sites, there may be an advantage from ubiquity, which may confer a benefit on the incumbent. This is illustrated by the fact that, in its 2016 analysis of market 4, CNMC found that the retail market share revenues of Telefonica in fixed business communications had fallen significantly for companies with up to 10 sites (although still remained about 60%), but had declined very little for businesses with more than 10 sites, remaining at 75.9% in 2014.[196] It also means that competitors to the incumbent seeking to win multi-site or multi-national contracts, are likely to require wholesale access, and will probably not be able to rely solely on the footprint of their own network.

Conclusions

The evidence tends to point towards a market for bespoke business ICT solutions which is distinct from mass-market broadband communication. Large businesses could not readily switch from such integrated solutions towards standardized site by site offers, and few suppliers would be well placed to achieve rapid entry into the supply of such specialist services.

However, some businesses may not purchase connectivity in this way, and may continue to purchase connectivity for specific sites or ask for telecoms connectivity to be split out within the quotations received from systems integrators. One could also view systems integrators as customers for site by site wholesale business connectivity, which they then integrate into wider solutions. Moreover, the digitization of industry and public services may encourage an increasing number of single site businesses and public service providers such as hospitals and schools to require dedicated connectivity. Thus, it is relevant to consider a market for connectivity to individual business sites, and, within this context, assess whether there is a distinct segment for business-grade connectivity or a common connectivity market including connectivity supplied to the mass-market.

An analysis of the performance characteristics of different technologies and the evolution of demand for connections to support smart industrial and public service applications, suggests that there may be a distinct market segment for dedicated (or guaranteed) high quality connectivity, which may be separate from the market for shared "mass-market" connectivity provided for residential and business use.

194 See Spain's 2016 market 4 Decision at https://circabc.europa.eu/sd/a/5f7c608d-d39d-4d6b-b6a9-87fc07b2421e/Proyecto%20Medida%20Mercados%203a%203b%204_18%2011%202015_PARTE%201_PUBLICA.pdf

195 See for example WIK (2015a) and WIK (2013).

196 See table 12 page 41 https://circabc.europa.eu/sd/a/5f7c608d-d39d-4d6b-b6a9-87fc07b2421e/Proyecto%20Medida%20Mercados%203a%203b%204_18%2011%202015_PARTE%201_PUBLICA.pdf

On the supply-side, the emergence of full-service providers in countries in which FTTH has been widely deployed for the mass-market (e.g. via PON) provide some signals that the entry conditions for dedicated access could become closer to those of the mass-market, over time. However, prior to the development of widespread FTTH, the providers, conditions (and locations) of competition may vary for supply of dedicated in comparison with mass-market connections.[197] Moreover, the multi-site nature of high-end business demand tends to reward operators with a “ubiquitous” network, and requires competitors to piece together access, potentially over a range of networks. There may also be geographic areas where FTTH has not been deployed to the mass-market (and may not be deployed in the long term, due to lack of viability), but where there remains demand for dedicated connectivity (e.g. from schools, hospitals and public institutions), with limited potential for competitive supply.

These factors may favour the identification of a separate retail segment for dedicated access, which should be examined in conjunction with the retail segment for shared mass-market data access for residential and business use.

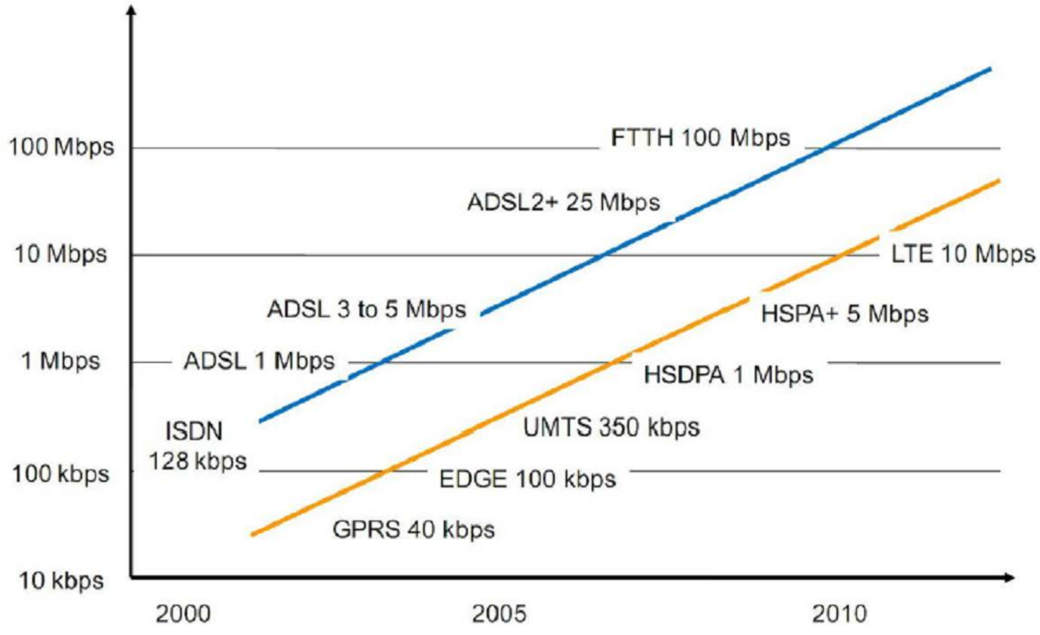
The distinction both on the demand and supply-side between mass-market “shared” data connections and “dedicated” or guaranteed connections, may not be present in countries where dedicated point to point fibre capacity has been deployed to the mass-market and where wholesale access is widely available.

5.1.3 Are mobile and wireless technologies part of the broadband retail market?

Although wireless and mobile broadband connections (including dedicated mobile broadband “dongles”) have existed for some time, mobile and wireless technologies have typically been excluded from retail broadband markets identified for residential and business customers. This has been due to persisting differences in the available bandwidths (see chart below), quality of service and reliability, as well as different pricing models such as data caps, which tend to limit the degree to which mobile broadband can be used in practice for data heavy applications including streaming, cloud services etc.

197 For example, in 2014 CNMC found that, while the largest providers of broadband services for the residential market were Orange-Jazztel and Vodafone-ONO, BT and COLT features amongst the 4 largest providers of services to businesses, with a much more fragmented market structure. In its 2020 proposals for the review of fixed telecoms markets, Ofcom conducted a separate analysis of competitive conditions for leased lines compared with mass-market broadband, on the basis that – at least for the moment – competitive conditions between the two markets are different. In this context, Ofcom noted the role that leased line only networks play in stimulating competition in the business segment (para 7.12 Ofcom 2020).

Figure 5-2: Comparing the capabilities of fixed and wireless technologies over time



Source: WIK-Consult (2016) Regulatory, in particular, access regimes for network investment in Europe

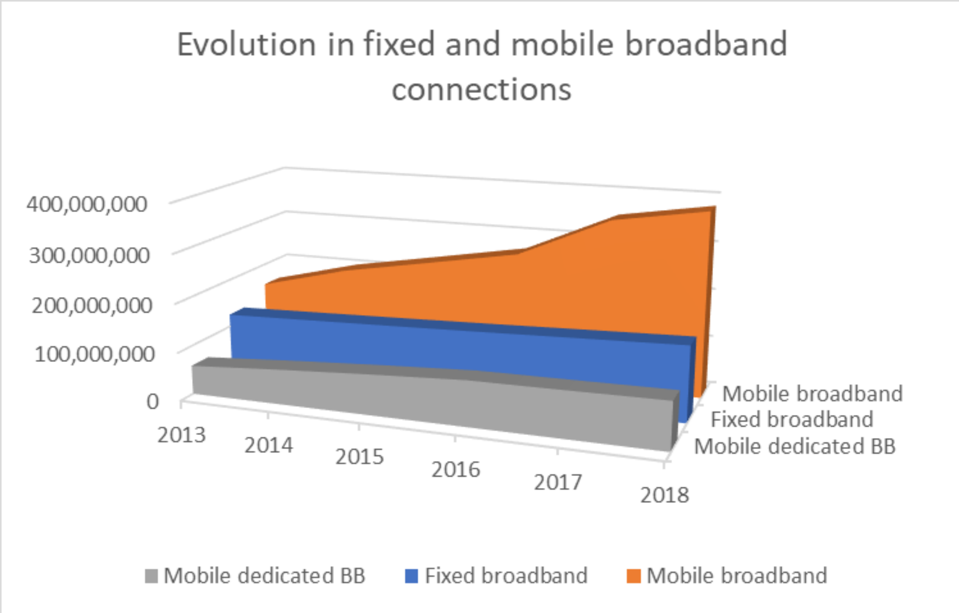
The fact that fixed broadband connections have expanded across the EU in tandem with mobile broadband (both smartphone and dedicated laptop connections)[198] tends to support the idea that the two are complementary. This is also supported by the Eurobarometer survey of 2017, which found that over six in ten households have both home and mobile internet, while 11% only had mobile Internet and 9% only fixed home Internet.[199]

Although, some use cases for fixed and mobile broadband may in the short term be similar, especially as consumers are expected to increasingly use mobile devices to access video, the shared nature of mobile infrastructure and limitations on the total bandwidth available (based on spectrum constraints and number and capacity of base stations), are likely to mean that a distinction remains between the services that can readily be accessed via mobile technologies and higher quality services (including over time 8KTV, cloud computing and services requiring augmented or virtual reality), which can be accessed over multiple devices via an FTTH connection (see Table 2-2).

198 Data gathered by project team through NRA survey October 2019. Mobile dedicated broadband refers to mobile broadband subscriptions designed to support connectivity on a laptop.

199 Directorate-General for Communications Networks (2018).

Figure 5-3: Evolution in fixed and mobile broadband connections



Nonetheless, there have been cases, especially in countries where lower bandwidths are prevalent in fixed wired broadband, where mobile or wireless technologies have been considered to substitute for fixed broadband.

In 2013[200], the Austrian NRA TKK (part of RTR) analysed the retail markets and concluded that the market for residential broadband access also included mobile broadband (MBB)[201] beside DSL[202], cable[203] and FTTH/B[204]. TKK included MBB as it observed switching between fixed and mobile broadband, MBB had a high percentage of customer satisfaction and TKK could not find significant differences in terms of prices, product characteristics or usage between fixed and mobile broadband. The separate market for non-residential customers encompassed only DSL and FTTH as cable and MBB would not be perceived as substitutes for business customers[205].

200 Case AT-2013/1475 and 1476.

201 MBB via UMTS, HSPA and LTE is offered by all three MNO's (A1, T-Mobile, Hutchinson 3 Austria), some MVNO's and some resellers. MBB is used for mobile applications (Smartphone) as well as for fixed services ("Cubes").

202 Approx. 98 % of households could be provided with broadband via xDSL.

203 In Austria, there are currently more than 150 cable operators, the main one being UPC, 100 of which offer broadband internet. Broadband via cable networks could be provided to approx. 50 % of households. Further deployment of cable cannot be observed.

204 FTTH/B coverage was limited to 2% of households by the end of 2014.

205 Cable is excluded from the market as the share of cable broadband connections in this segment is constantly below 10 % and almost no changes from DSL to cable broadband could be observed in the past. MBB is not part of the market because the growth of MBB in this segment has been low, practically no companies with currently exclusive fixed broadband plan to switch to MBB and there are currently no genuine business customer products. Also even significant price increases by A1TA in fixed business customer combination products in 2012 did not result in a decline of uptake or switching.

However, in an analysis in 2017[206], which was conducted after the deployment of FTTC by the incumbent, TKK reached a different conclusion, and removed mobile broadband from the scope of the residential market. In supporting its decision, TKK observed that a mobile only operator would - in the absence of fixed wholesale access products - face significant competitive disadvantages towards A1TA (which was the only fully integrated mobile and fixed operator at the time), as their mobile networks would face difficulties to cope with growing data consumption needs. The growing data consumption would require the possibility to route traffic via a fixed network. Otherwise, the mobile operators' ability to compete would likely be inhibited.

Another recent case in which wireless technologies have been included in the retail and associated wholesale market for broadband access is Croatia. In 2019, the NRA included “hybrid” broadband access within the scope of broadband markets and obliged the incumbent HT to provide wholesale access based on this technology, upon reasonable request.

Hybrid broadband access is a relatively new retail service in Croatia (launched in 2017), marketed as „Turbo Mix opcija” and only offered by incumbent HT[207]. Hybrid broadband access consists in an xDSL fixed broadband access service with the add-on of a mobile data connection containing 100 GB of data traffic monthly to improve download/upload speed. It is offered in combination with ADSL services with a maximum download speed of 20 Mbit/s improving the speed to 30/5 Mbit/s.[208] However, the increase of the rate depends on the mobile network characteristics at the specified location, and there is no guarantee.

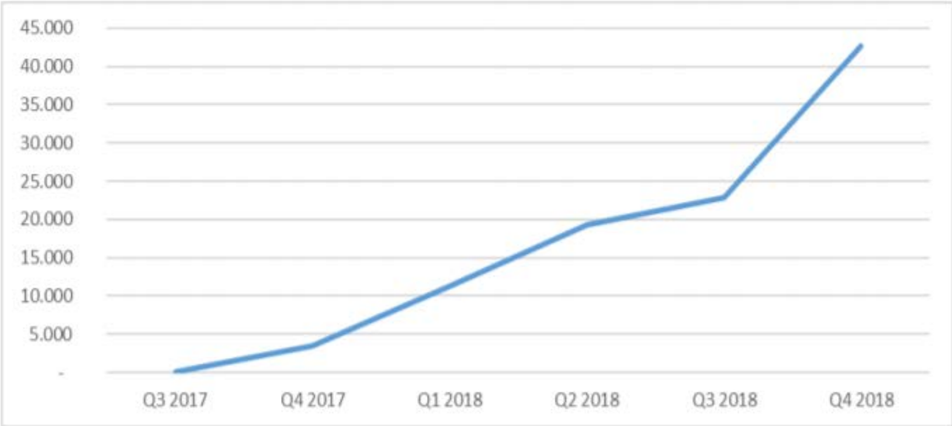
Hybrid broadband access in Croatia is offered via a hybrid modem/router, which connects to the copper pair but in addition contains a SIM card. The mobile broadband is used when the fixed network component reaches 90% of its capacity. The mobile data card in the modem enables speeds up to 30 Mbps download and 5 Mbps upload. The hybrid modem is also capable of directing traffic over the mobile network in case of xDSL line failure.

The service is well accepted by end users, as can be seen in Table 1. By the end of 2018, the market share of hybrid broadband connections was 3.8%. The actual demand for such hybrid access products could be greater as the supply has been restricted by HAKOM[209] until it assesses the impact of such products on the market for broadband access. Fixed wireless access (based on 4G mobile broadband) is also provided in Croatia through a service called ‘Homebox’ for residential users[210] and Officebox[211] for business users. The market share of this service was 8.31% as of mid 2019. It should be noted however that the service is subject to bandwidth and usage constraints. Specifically, only the first 100GB of

206 Case AT/2017/1987+1988.
207 The monthly price for the aforementioned option is 10 HRK (1,35 EUR) and this option allows the user to have access of up to 30 Mbit/s and 100 GB of data traffic which the user can exert through the mobile network.
208 Hrvatskitelekom (2020).
209 In February 2018, HT requested and HAKOM, approved the increase of ADSL users up to 50 000.
210 A1 (2020a).
211 A1 (2020b).

Internet traffic is available at the highest speeds, after which speeds drop to 2Mbit/s. Unlimited data traffic with no speed limit applies only between midnight and 10am, and the provider notes that the maximum Internet speed depends on the 4G signal level, current network load and device model.[212]

Table 5-2: The number of users of the hybrid broadband access



Source: Hakom

Moreover, it should be noted that the context of the success of wireless technologies in Croatia mirrors to some degree the circumstances in which mobile broadband was found to be a substitute for fixed broadband in Austria. Notably, as of mid-2019, 63% of broadband lines in Croatia relied on copper access connections[213] and more than 68% of broadband users in Croatia have connections with download rates below 30 Mbit/s[214]. It is thus possible that current substitution patterns might change once FTTC/VDSL and higher bandwidth technologies are widely deployed and accepted in the market.

However, as observed by the European Commission in its comments letter to the Austrian authorities in 2017,[215] further developments in wireless technologies could again potentially bring wireless technologies back into contention.

An important upcoming development is the deployment of FWA via 5G.

An analysis of the technological potential of 5G FWA (see 2.6.5) shows that it can offer Gigabit connectivity and provide an alternative for some fixed technologies.

212 A1 (2020a).

213 Q2 2019 data gathered via questionnaire in the context of this study. A high proportion of these lines are understood to have been provided via VDSL technology at the CO. As of end 2017 only 43.47% of connections relied on ADSL. FTTC/VDSL is not widespread in Croatia, representing just 2% of lines in Oct 2019 (Hakom 2019, p 16).

214 The largest number of users (42%) have download rates between 10 and 30 Mbit/s while 32% of users have even between 2 and 10 Mbit/s.

215 The EC directed the RTR in 2017 to monitor the technological developments in particular in light of technical developments (LTE/5G) and data consumption.

There is also some evidence that it could be deployed to a significant degree in Europe.

FWA is already established in Italy. FWA connections increased from 2.5% to 7% of all broadband connections in Italy between 2013-2019.[216] As a next step, Fastweb has carried out the first 5G Fixed Wireless Access trials in Italy and commercially deployed FWA in 2 cities, with the aim of reaching 90% national coverage by 2026.[217] In Fastweb's deployment, the mobile base station is located along the main street and connecting CPE is installed outside on balconies. With such a deployment, there is no need for civil works and Fastweb claims that speeds up to 1 Gbps can be achieved with a maximum of 500 meters. In the USA, 5G FWA was also launched at the end of 2018 with a performance of at least 300 Mbit/s, which makes this form of FWA a substitute for lower end FTTH services.

In Korea, 5G FWA has been launched not only for residential customers (with national coverage by end of 2019) but also for businesses.

5G FWA has been cited as a means of supporting homes in rural, remote and hard-to-reach areas.[218] It could also provide a mechanism in other areas for new entrant operators to compete with end-to-end fixed infrastructure offers.[219]

However, its capabilities lie at the lower end of the bandwidth capabilities of upcoming generations of fixed cable and fibre technologies and it is unlikely to be considered a good substitute in countries where fibre technologies are already widely deployed.[220]

It should also be noted that, on the supply side, provision of 5G will involve relatively deep fibre deployment in the network, and this heavy reliance on fixed infrastructure is likely to favour the provision of such services by converged operators with extensive fibre already in place. Thus, potential demand-side substitution might be countered with increased reliance on fixed infrastructure on the supply side.[221]

A number of respondents to the Commission's consultation raised the prospect of wireless technologies providing competitive constraints to fixed technologies in the timeframe of the next review.[222] However, other respondents highlighted an opposing trend involving the

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216 NRA data provided to project team October 2019.

217 Fastweb (2019).

218 In the ongoing Ecorys study for the Commission concerning implementation of the CEF2 Digital programme, WIK modelled the use of 5G technologies to serve remote areas as a cost-effective alternative to FTTH in those situations.

219 MicrowaveJournal (2019).

220 Fixed wireless access has tended to play a specific role for rural areas in countries such as Sweden and Estonia, which benefit from extensive fibre. Interviews conducted for this study also confirm that mobile operators/fixed broadband challenges see a less significant role for FWA in cases where fibre is extensive.

221 This is further discussed in Marcus and Godlovich (2013) as well as WIK (2016b).

222 For example - Dansk Energi observed that the further integration between fixed and mobile networks will not only increase competition between mobile and fixed infrastructure (4G already reaches 100 Mbit/s), but will also give operators with both infrastructures to create unique hybrid services. However, this brings also the subsequent risk of new forms of anticompetitive behavior and requires new regulatory approaches and competences from the national regulatory authorities (NRA). ETNO and PT Portugal also noted that it sees as a key trend, the more dynamic competition between access infrastructures, being fixed, mobile from different technologies.

increasing prevalence of fixed mobile hybrid and bundled offers where fixed and wireless services are provided as complements, increasing the difficulties for operators without access to one of these services to compete in the market,[223] while others highlighted gaps in performance between 5G mobile technologies and the most modern fibre technologies.[224]

Conclusion

In conclusion, hybrid offers, FWA and mobile broadband seem only to provide a full functional substitute for fixed connectivity in specific circumstances today (mainly where fixed networks have yet to be fully upgraded to NGA, or where it is not economically viable to deploy NGA fixed networks e.g. in very rural areas). The upcoming deployment of 5G offers the prospect for FWA to provide long term Gigabit connectivity in rural areas in place of fixed connections. 5G FWA could also become a credible substitute more generally, but its capabilities are limited to the lower range of bandwidths possible via upgraded FTTH networks, and is thus the use of 5G FWA in urban settings is likely to be more relevant in countries and areas where FTTH is not already widely deployed. Such patterns of substitution might also change over time in cases where FTTH is deployed in the future. The potential for alternative operators to supply fixed wireless and mobile 5G technology also depends on the degree to which such operators can deploy or access fibre backhaul.

NRAs should consider whether in the circumstances present in their market, 5G FWA should be included in the retail market for mass-market broadband connections, but in doing so, they should also consider the degree to which the current status in fixed infrastructure deployment has reached its end-state (which may be the case in rural areas) or is likely to further evolve over the period of the market review.

FWA is used for and is likely to be deployed for the use of business as well as residential connectivity. However, it may not be able to support the most highly demanding business requirements, which currently rely on dedicated point to point fibre connections. It is thus unlikely to be relevant for inclusion in any market segment associated with dedicated business-grade infrastructure.

223 For example United Internet (DE) noted that fixed mobile convergence at retail side and because certain combinations of fixed and mobile retail services are not even replicable, hence competition decreases further.

224 For example Open Fiber observed that the market definition of fixed and mobile markets will most likely not be affected by 5G. There will be differentiation between the two markets on aspects like data caps and bandwidth stability and reliability, therefore the mobile market will continue to be separate from the fixed market.

5.1.4 Is there scope to segment the market by technology or speed?

NRAs have generally considered that copper, cable and fibre-based technologies all lie within retail broadband markets and that there is a chain of substitution within the broadband mass-market spanning basic broadband offers via ADSL technology through to Gigabit offers as may be provided via cable or FTTH. The assumption inherent in this approach is that charges for basic broadband should constrain the price of higher bandwidths. Anchor-pricing approaches, such as that pursued by the UK NRA Ofcom, are based on this premise. Under this approach, the NRA focuses on ensuring cost-oriented pricing in „entry-level“ broadband services (e.g. by regulating key wholesale inputs on the basis of cost-orientation) while refraining from charge controls on higher speeds, on the basis that retail prices for those speeds (and wholesale prices, if wholesale access is subject to a non-discrimination obligation) will be constrained via the chain of substitution.

However, there are some signs that, over the next decade, service and technological developments, coupled with the retirement of legacy networks, may introduce breaks in the chain, for both residential and dedicated business services.

5.1.4.1 Mass-market broadband connectivity (for residential and business use)

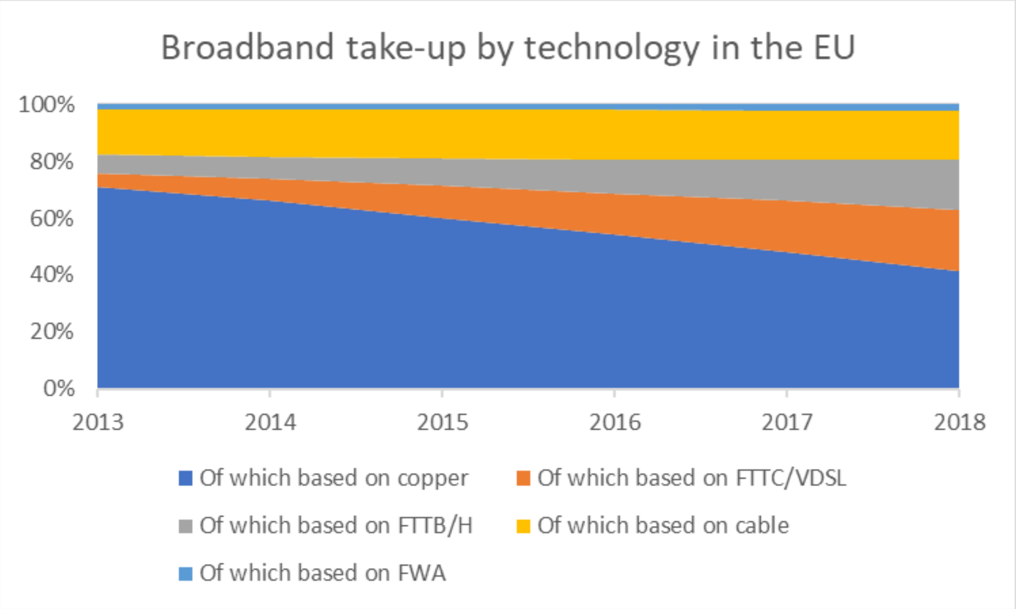
Firstly, and importantly, bandwidths achievable via the most modern Gigabit networks are already many times higher than those available via copper. This gap is set to increase as copper reaches its technological limitations whilst fibre still provides scope for growth (see chapter 2.6.3).

From the demand-side also, copper-based broadband is unlikely to be able to deliver some key services and applications that more advanced consumers demand. Analysis by WIK of the bandwidths required to support multiple-device use (set to expand with IOT-based smart applications in the home), video-conferencing, next generations of TV (including 8K), and upcoming AR and VR applications, suggest that copper will no longer be adequate to meet most household needs, or those of small businesses and home workers.[225]

Trends in usage also show migration from copper to higher performing technologies, but not vice versa (see following chart). Once a critical mass of customers has migrated and is benefiting from the services that are possible via higher bandwidths and have acquired more advanced equipment such as higher definition TV or VR gaming equipment, such customers might not switch back to legacy technologies, even if prices for Gigabit technologies were to increase.

225 WIK (2018a). See also analysis under chapter 2

Figure 5-4: Broadband take-up by technology in the EU



Source: WIK based on data gathered from NRA questionnaire October 2019

Likewise, after having encouraged all customers that might readily switch from copper-based broadband to fibre-based technologies to do so through approaches to relative pricing,[226] there may be limited incentives for operators to offer attractive deals for those customers remaining on copper, as they have shown themselves to be reluctant to switch. Indeed, a rational approach might rather be to increase prices for those remaining on copper-based services to levels at or even above those of fibre-based services to further encourage switching and/or exploit the potential to reap supernormal profits with respect to these customers.

Ultimately, such efforts to promote voluntary migration are likely to be followed by forced migration, as operators which have invested or co-invested in fibre infrastructure seek to switch-off the legacy network to realise cost savings and support the business case for the new fibre network.[227] Once switch-off is planned, a forced break in the „chain of substitution" will occur, and previous constraints from legacy technologies towards higher bandwidths will no longer apply.

The Swedish NRA PTS, recently concluded in its draft market analysis of the wholesale local access market that copper (including FTTC/VDSL) and higher bandwidth technologies (cable and FTTH) are in separate markets.[228]

226 For example, in Spain, the incumbent set prices for the "entry-level" FTTH offer of 50Mbit/s at the same level as ADSL to encourage migration.
227 Copper switch-off progress and migration strategies are described in WIK (2019b).
228 PTS (2019b).

In its draft Decision concerning the „copper" market segment for market 3a, PTS noted an increased trend towards use of streaming services in Sweden,[229] alongside the use of such services on multiple devices, thereby requiring greater capacity. PTS also noted that Sweden had the third highest use of cloud storage within the OECD. In 2017, Swedish households had an average of 12.7 Internet connected devices, which included not only computers, tablets and smartphones, but also TVs, speakers and other connected objects. PTS noted that a transmission speed of 10Mbit/s (as may be available via copper) would be sufficient to perform some basic functions, but not advanced usage on multiple devices of the type increasingly seen in many Swedish households. PTS also noted significant differences between the quality characteristics associated with fibre (such as lower packet loss and delay of 13 milliseconds on average) compared with a delay of 39 milliseconds over copper, which would affect users' ability to make use of certain applications.

Ultimately, PTS concluded that copper was in a separate market from fibre and cable connections because „in PTS' estimation, end-users would not be prepare to switch their connection technology from fibre or cable towards copper based on a small but significant price increase. This was due to the fact that end-users with broadband services via fibre networks generally have services with higher transfer rates and at lower prices than broadband services via copper networks." PTS also observed that a large proportion (61%) of customers with broadband services via copper networks also had the option to connect via fibre networks, while 29% had the option for cable broadband. PTS concluded that the fact that they had not switched, may mean that they had different demands.

Sweden is advanced by comparison with many other countries in Europe when it comes to deployment of FTTH, usage of online services and the proliferation of devices. Copper switch-off has also begun in Sweden, although it has focused to date on rural areas, where copper broadband is being replaced with mobile access.[230] Experiences from the Swedish market may thus give insights into developments that are likely in other countries as coverage of FTTH increases and the voluntary migration is well under way. It may thus be reasonable to expect, over the period of the next Relevant market Recommendation that (as with the experience of analogue leased lines and ISDN in some business markets), copper-based broadband will increasingly become confined to a group of users which have different usage patterns and fewer bandwidth demands, and are reluctant to switch. In this context, constraints may weaken and the chain of substitution between higher bandwidth cable and FTTH technologies and ADSL (and potentially FTTC/VDSL) depending on the pace of migration may be broken. In turn, a broadband market focused on lower bandwidth copper-based technologies may be more open to functional substitution by mobile broadband, as observed in the EC comments concerning the Swedish proposal to segment copper and

229 53% of Sweden's population have access to at least one subscription for streaming, while 85% of Internet users watch video and movies online.

230 As of 2018, 42% of copper exchanges had been switched off. These were predominantly located in rural areas, where the replacement technology was mobile (WIK 2019b).

VHC markets,[231] and as suggested in the Austrian and Croatian cases as described in section 5.1.3.

5.1.4.2 Dedicated connections

In contrast to residential markets, cable has often been excluded from the scope of high quality markets, and a number of NRAs have identified bandwidth, interface or technological breaks in this market.

In some cases, including several countries in Eastern Europe,[232] NRAs have found that lower bandwidth (copper-based) leased lines were not characterised by effective competition, while higher bandwidth lines (typically provided via fibre) were considered to be competitively supplied e.g. on the basis of an analysis of market shares and the presence of infrastructure-based alternative providers deploying fibre.

However, NRAs in Austria and the UK reached the opposite conclusion. For example, in its 2019 Business Communications Market Review, the UK NRA Ofcom segmented the market for traditional interface services up to and including 8Mbit/s. It found that beyond the period of the review, there were clear dynamics suggesting that effective competition would be reached in the foreseeable future.[233] Ofcom confirmed this conclusion in its 2020 consultation on fixed access markets and continues to propose that copper-based connections (Ethernet in the First Mile) no longer constrain other leased line services and should be excluded from the market.[234] Meanwhile in its 2018 HQA review,[235] the Austrian NRA TKK concluded that for the market of terminating segments of leased lines with traditional interfaces, no competition concerns could be identified, and referred to the SMP Guidelines provisions which state that „once most customers have switched to a higher performing infrastructure, a group of users may still be using the legacy technology. In this event, NRAs should take a regulatory approach that does not unduly perpetuate the cycle of captivity by defining overly narrow markets".

It is possible for both conclusions to be correct, as they may reflect differing degrees of reliance on copper-based infrastructure in the different countries. However, the conclusions reached in Austria and the UK point to the fact that, as in Sweden for mass-market broadband, it may be relevant in the business segment to segment legacy technologies and interfaces, especially when their use is in decline, on the basis that remaining demand is limited to certain customers which showing switching reluctance, and that regulation should not seek to perpetuate reliance on legacy technologies.

231 Case SE/2019/2217.

232 For example, the Czech regulator found that the incumbent had SMP in bandwidths up to 6Mbit/s, but not above, while the Polish NRA segmented at 2Mbit/s in its 2015 Decision

233 Case UK/2019/2170-2171

234 Ofcom (2020).

235 Case AT/2018/2071.

As regards higher bandwidth leased lines, in both Austria and the UK, it is notable that the NRAs found the incumbent had SMP for the provision of these connections only in certain geographic areas (rural or outside dense business districts). It is possible that, if a geographic segmentation of this kind, had been conducted in countries which deregulated higher bandwidth (or all) leased lines, this may also have highlighted regional variations in the degree of competition in higher bandwidth lines, reflecting the fact that the infrastructure of alternative operators is often concentrated in specific regions.

A further question arises as to whether any bandwidth segmentation should be applied on higher bandwidth leased lines, typically provided via fibre. Some NRAs such as BNetzA have segmented higher bandwidth leased lines and set a cap of 155Mbit/s, above which such lines are considered to be competitively supplied. BNetzA justified its decision on the basis that the market segment above 155Mbit/s does not meet the three criteria test because leased lines with very high bandwidths are predominantly in demand in and between urban areas where many alternative network providers are already represented with their own infrastructures. BNetzA does not consider that there are significant or persistent entry barriers in this segment.[236]

However, other NRAs such as RTR, ComReg and Ofcom have concluded that there is a chain of substitution encompassing leased lines of all bandwidths. For example, in its 2019 Business communications market review, and the 2020 consultation on the fixed telecommunication market review, Ofcom noted that where a telecom provider has an existing connection to a customer site, it can be used to provide a full range of leased line services (at all bandwidths), because the underlying material (optical fibre) is in place, and can be adapted to provide different bandwidths based on an adjustment to or upgrade of the electronic equipment.[237] Conversely, digging behaviour of alternative operators suggested that digging was infrequent for all bandwidths. Similarly, ComReg found that differences in competitive conditions for higher bandwidth leased lines are associated with geography and proximity to alternative operators' existing networks, rather than the bandwidth offered.[238]

It is possible that, at the time when the analyses were conducted, these contrasting conclusions were both correct. However, as demand for dedicated connections is expected to increase beyond areas where it is currently present, due inter alia to the deployment in time of 5G small cells, and the digitisation of industry and development of smart solutions for public services such as education and healthcare, it seems likely that a geographic analysis without segmentation on bandwidth may be appropriate. Indeed, it is notable that ComReg identified a market segment for leased lines in which there were no premises that were at that time connected with leased lines.[239] However, it concluded that eir nonetheless had SMP and was obliged to provide access in this area as it may have been the only operator

236 Case DE/2016/1933.
237 Paragraph 6.73 in Ofcom (2020).
238 Case IE/2019/2214.
239 See discussion of area 4 in Case IE/2019/2214.

capable of deploying connections in some cases. Similarly, in 2020 Ofcom concluded in its proposed analysis of fixed telecom markets, that proximity to existing networks was a key determinant of whether an alternative operator could deploy a new leased line “on demand”. Build-out by alternative operators to areas with limited existing network competition and low current demand for leased lines was considered unlikely.[240] The view that the viability of construction of new leased lines “on demand” by providers of leased line services depends on the location of the premise to the existing network nodes was confirmed inter alia in interviews conducted with BT and COLT for this exercise.

If the market segment specific to business-use is restricted to dedicated connections, and thereby excludes shared access, cable would normally not be considered a substitute in this market.

Conclusions

Copper is likely to play a declining role for both mass-market and „dedicated“ leased line connections over the course of the period covered by the revised Recommendation on Relevant Markets. Once migration is well progressed, services based on copper may no longer constrain the prices charged for more performant technologies. When this happens, a separate segment could be identified for services based on copper technologies. It should be considered whether mobile and/or wireless technologies and upgraded copper (FTTC/VDSL) also falls within this segment.

Within the remaining high capacity segment, it seems likely that there will be a chain of substitution across different speeds, due to the potential to upgrade existing connections to higher bandwidths at relatively limited cost.

Cable broadband networks (where present) are likely to fall within a market segment covering mass-market services for residential and business use, but outside a retail market segment for dedicated business-grade connectivity.

5.1.5 Conclusions around the scope of the retail market(s) for mass-market and high quality connectivity

Drawing on our analysis, we propose the identification of separate retail market segments covering respectively „mass-market (shared) data connectivity for residential and business use“, and dedicated high quality access for business use.

In the (relatively few) cases where point to point FTTH infrastructure has been widely deployed to the mass-market, such that the same infrastructure is used to supply both

240 See paragraph 7.75 Ofcom (2020).

residential consumers and SMEs, alongside larger business sites, a single market could be found on the basis of supply-side substitution.

5.1.6 Do the retail market(s) for data connectivity for residential and business customers tend towards effective competition?

When considering the degree to which mass-market and high-quality connectivity markets tend towards competition, it is necessary to consider how these markets would be likely to evolve in the absence of existing wholesale SMP regulation (modified greenfield approach).

A key question in this context is the degree to which sustainable competition can be expected to emerge at the retail level in the absence of SMP regulation (of at least PIA), but in the presence of other forms of regulation that are or may be applied independently from SMP regulation. Such regulation includes:

- obligations under the 2014 Broadband Cost Reduction Directive[241] on all owners of physical infrastructure capable of hosting telecoms infrastructure to provide access to that infrastructure on reasonable request and to collaborate in the deployment of infrastructure (co-deployment); and
- obligations that may be applied under the EU Electronic Communications Code for all operators to share access to infrastructure up to the first distribution point or potentially beyond – in accordance with Article 61 of the Code.[242]

5.1.6.1 Retail mass-market for data connectivity

Models concerning network replicability that were developed in the period before duct and pole access were widely implemented in Europe show that the scope for alternative operators or investors to profitably replicate access infrastructure with FTTH was limited.[243]

However, even at that time, models prepared by WIK of viable replicability of FTTH infrastructure in Paris, highlight that the availability of duct access at a reasonable price and on fair terms and conditions (in that case via sewers) could impact the viability of replication significantly.[244]

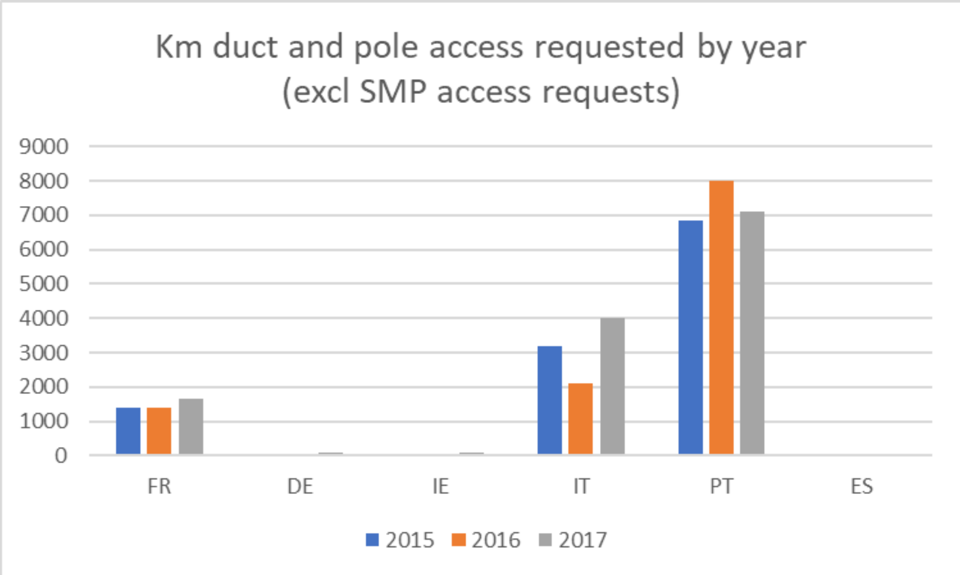
Subsequent experience in countries which have widespread duct and pole access show that it can have a significant impact on the prospects for competition for both mass-market and business connectivity, at least in densely populated areas.[245] However, countries in which

241 European Parliament (2014).
242 European Parliament (2018).
243 See for example WIK (2008).
244 WIK (2008, p. 144).
245 See section 3.1.3.2.

competition has evolved on the basis of duct and pole access such as France, Spain and Portugal, have mostly relied predominantly on SMP duct and pole access.

The impact of duct and pole access mandated under the Broadband Cost Reduction Directive or similar previous national provisions on infrastructure-based competition, has been more limited thus far, as can be seen the following chart.

Figure 5-5: Non-SMP Pole and duct access requested (km) per year 2015-H1 2017[246]



Source: WIK/VVA based on telecom operator surveys (except FR – sourced from utilities)

With only a few exceptions, NRAs providing data in the context of this study, were not able to provide comprehensive data on the usage of utility infrastructure for the deployment of telecom networks. However, data provided from those that were confirms that BB CRD-based duct access use appears considerably more limited than SMP duct access use, although the use of utility poles to deploy telecom infrastructure (often in rural areas) is more common, in countries such as France, Portugal and Malta.

Although it came into force in 2016, the BB CRD has only recently been implemented in many countries. It is possible that with more active enforcement, the usage of utility infrastructure to deploy telecoms networks could increase. However, it seems unlikely that it would be used as an alternative in countries which already have established SMP duct and pole access regimes, especially since the use of utility infrastructure can raise additional challenges in relation to safety and technical competence, compared with telecoms duct and

246 Data from DE is drawn from responses from 6 operators, including large players. However, it may still be incomplete in view of the fragmentation in network deployment in DE. With the exception of records from three telecom operators and 1 utility provider, data for 2017 covers H1 2017 only. Full year data could be expected to be higher.

pole infrastructure, can be regionally fragmented (in contrast with the national network of the SMP telecom operator) and may not mirror the routes taken by telecoms operators.[247]

The BB CRD also applies to telecom physical infrastructure. It is thus possible that duct and pole access obligations which are currently mandated on incumbent operators via the SMP regime could instead be enforced via the BB CRD. Countries such as Bulgaria, which have taken a pro-active approach towards implementation of the BB CRD have indeed concluded that it could effectively replace the need for SMP duct and pole access regulation.[248] However, SMP duct and pole access regulation has been maintained in most countries examined alongside the BB CRD (see Table 5-4), and for the BB CRD to be capable of replacing SMP duct and pole access regulation more widely across the EU, it would require ex ante intervention and considerably more detailed enforcement than is envisaged under the BB CRD as construed today. Given its symmetric nature, applying more detailed rules under the BB CRD could also result in non-incumbent operators having to meet onerous obligations, which may not be proportionate in view of their size and geographic coverage. Lastly, it should be noted that, the BB CRD provides that pricing for access to physical infrastructure provided by operators offering broadband infrastructure should reflect the impact on their business case.[249] This means that, in contrast with SMP regulation, the BB CRD is likely to be less effective than SMP regulation in ensuring cost-effective access to telecoms infrastructure.

In conclusion, it cannot be assumed that BB CRD-based access alone can be expected to support sustainable competition in retail data markets across Europe. If the provisions of the BB CRD are strengthened under the upcoming review of the Directive, this conclusion could change. However, the outcome of that review is uncertain and any changes are likely to take time, given the need to adapt and implement the legislation.

Some operators have been able to deploy infrastructure in parallel to the incumbent without needing to rely on SMP or BB CRD access. For example, Cityfibre in the UK has used microtrenching for some of their FTTH deployments.[250] Meanwhile, some utility companies and organisations have made use of their own infrastructure to deploy FTTH, notably in Denmark, Ireland, and recently in Flanders, Belgium, where Fluvius is entering the market for supply of Gigabit broadband.[251] In cases where the entry of these competitors occurs alongside incumbent and cable networks, there may be the prospect of sustainable competition. However, deployment by these operators often occurs in areas in which there is no cable network, has to a large extent been regional and is specific to certain countries. Thus, competition from new entrants on the basis of their own duct infrastructure or

247 Some of these issues are raised in WIK (2018c). Ofcom also refers to such challenges in Ofcom (2019).
248 The Bulgarian NRA concluded in 2019 that the WLA market was effectively competitive (case BG/2019/2155). One of their supporting arguments was that the Electronic Communications Networks and Physical Infrastructure Act (ECNPA) – the national transposition of the BB CRD, exceeds the Directive's requirements to a significant extent.
249 Recital 19 BB CRD in European Parliament (2014).
250 ISPreview (2019d).
251 Glasvezel (2020a).

deployment using cost-efficient techniques such as microtrenching is unlikely by itself to result in a significant change to competitive dynamics for access to data connectivity across Europe as a whole.

A further question concerns the degree to which symmetric obligations under the Code may support sustainable competition in retail data services. It is necessary in this context to define what is meant by symmetric access. Article 61 of the Code provides that:

- NRAs may impose access obligations up to the first concentration or distribution point (FCDP) as determined by the NRA – subject to evidence that replication would be economically inefficient or physically impracticable

- Where such obligations (as well as SMP obligations) do not sufficiently address high and non-transitory economic and physical barriers to replication significantly limiting competitive outcomes for end-users, symmetric access may be extended beyond the FCDP to a point capable of hosting a sufficient number of end-user connections to be commercially viable for efficient access seekers

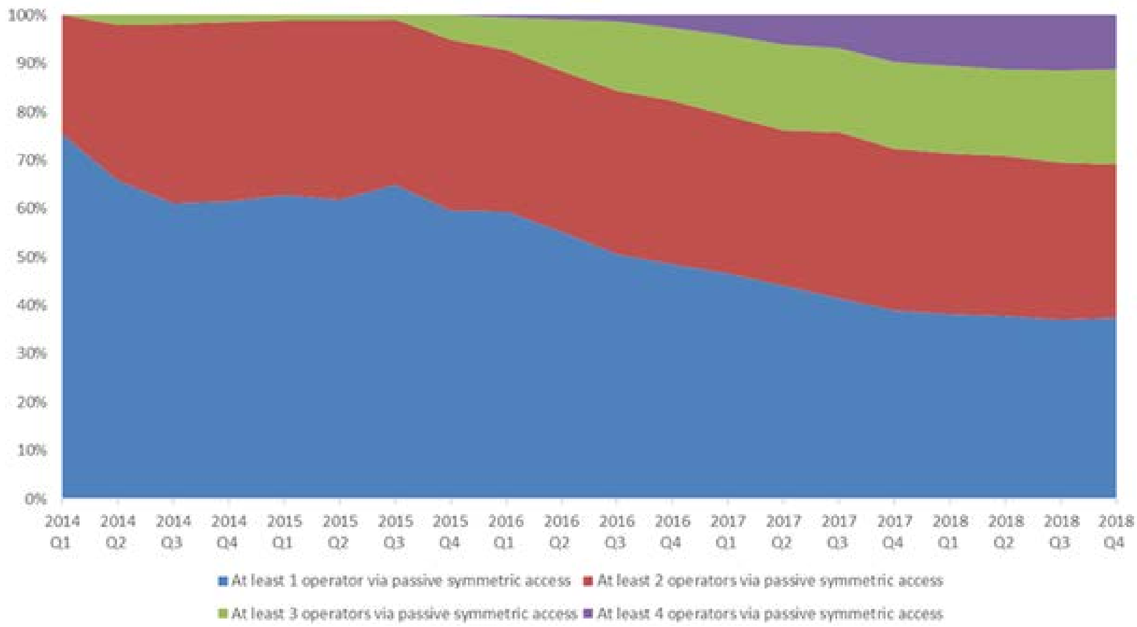
- If justified on technical or economic grounds, NRAs may impose active or virtual access obligations

In practice, symmetric obligations imposed prior to the Code have been applied in different ways. The contrast can be most starkly seen when looking at the application of symmetric regulation in France compared with Spain and Portugal.

In the French case, in areas defined as „less dense“ by the NRA, all operators installing fibre in building must offer passive wholesale access or co-investment (via 20+ year IRU) at a mutualisation point gathering at least 1,000 households. This can be seen as a variant of physical unbundling of fibre infrastructure, but imposed via symmetric obligations and following a different pricing regime (co-investment via IRU) than the typical short-term rental used for copper SMP access. In the French case, the NRA concluded in the context of its market analysis that symmetric regulation mandating access to fibre (termed mutualisation) coupled with SMP duct access was sufficient to support competition in mass-market broadband.[252] Indeed, the data shows (see following chart) that this regime has contributed to increasing levels of competition in fibre-based broadband outside the very dense areas where infrastructure-based competition has developed.

252 ARCEP (2017a).

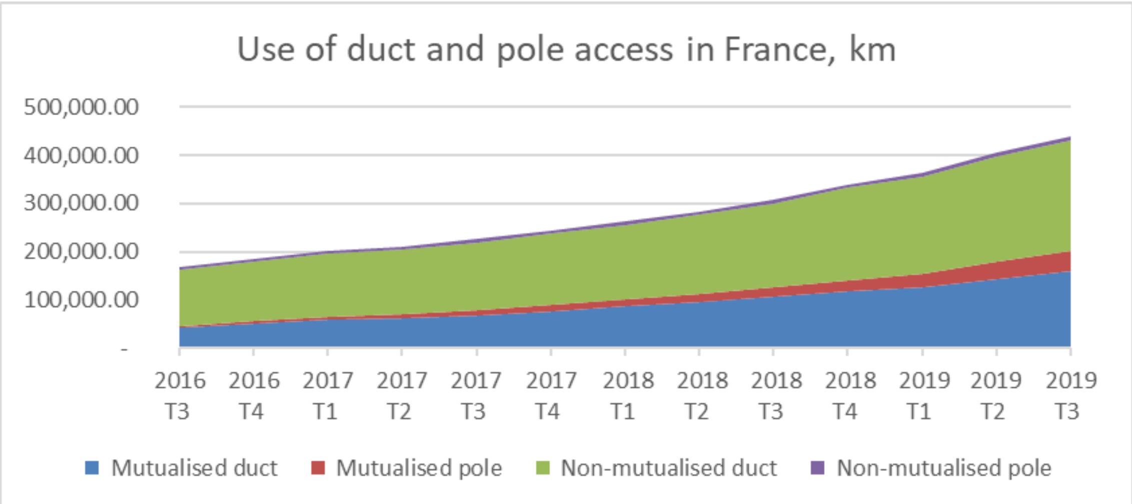
Figure 5-6: % of customers having a choice of FTTH retail provider: (commercial less dense zones)



Source: ARCEP data

However, it is notable that the development of competition under this regime has relied on duct and pole access, which is mandated under the SMP regime, and is widely used in France (see chart below).

Figure 5-7: Civil Infrastructure usage in France (km)



Source: ARCEP data

Moreover, in its most recent market analysis decisions, ARCEP complemented the symmetric regulatory regime with SMP regulation on certain aspects of FTTH lines used for business provision, suggesting that symmetric regulation alone, even in this extensive form, was insufficient to address competition problems in the market.

It should also be noted that the extensive form of symmetric regulation pursued in the French market has been introduced to meet very specific conditions, which may not be relevant to other countries. These conditions include, agreement amongst all operators that passive access should be promoted, and the existence of a number of operators intending to deploy FTTH for the first time, commercially or with the aid of subsidies. The proliferation of different providers in different regions – both in commercial and „public initiative“ zones also necessitated rules which would impose common characteristics for the products offered to facilitate access and support competition in retail services at a national level.

Conversely, other NRAs which have mandated symmetric regulation, including those in Spain and Portugal, have focused symmetric obligations on access to wiring only for in-building writing or at a distribution point close to the building. For example, the Points of Interconnection for symmetric access mandated in Spain are illustrated in the diagrams below. The Spanish NRA concluded that there are some circumstances (for efficiency and to address lack of economic viability) in which it is justifiable to mandate symmetric access at points beyond the building.[253] However, it is not clear how far this exception has been implemented, and the connection point in these cases would not extend to the 1,000 households covered by the French regime. Meanwhile, in Portugal, one access point is provided for each building, at a point known as the “multioperator chamber”.

253 RESOLUCIÓN POR LA QUE SE APRUEBA LA IMPOSICIÓN DE OBLIGACIONES SIMÉTRICAS DE ACCESO A LOS OPERADORES DE COMUNICACIONES ELECTRÓNICAS EN RELACIÓN CON LAS REDES DE FIBRA DE SU TITULARIDAD QUE DESPLIEGUEN EN EL INTERIOR DE LOS EDIFICIOS Y SE ACUERDA SU NOTIFICACIÓN A LA COMISIÓN EUROPEA of 12.02.2009. Further details of the standards applied and connection points are described in WIK (2018c).

Figure 5-8: PoIs for symmetric access to in-building wiring

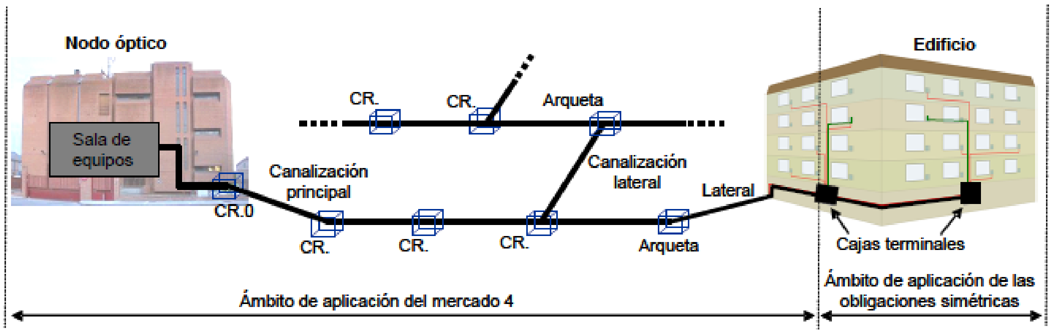


Figura 1. Ubicación del punto de compartición en el edificio.

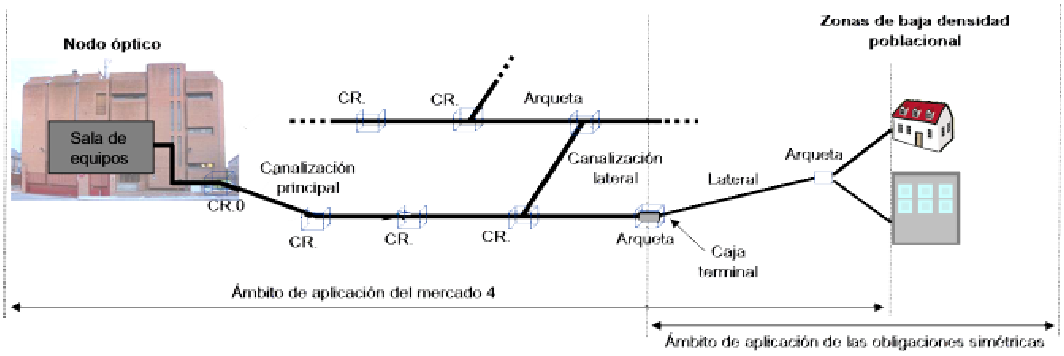


Figura 2. Ubicación del punto de compartición en dominio público (arqueta cercana a las edificaciones).

Definitions:
CR: manhole
Arqueta: handhole
Caja terminal: Building Distribution Box

Source: RESOLUCIÓN POR LA QUE SE APRUEBA LA IMPOSICIÓN DE OBLIGACIONES SIMÉTRICAS DE ACCESO A LOS OPERADORES DE COMUNICACIONES ELECTRÓNICAS EN RELACIÓN CON LAS REDES DE FIBRA DE SU TITULARIDAD QUE DESPLIEGUEN EN EL INTERIOR DE LOS EDIFICIOS Y SE ACUERDA SU NOTIFICACIÓN A LA COMISIÓN EUROPEA of 12.02.2009, p.17

Moreover, as in France, NRAs in Spain and Portugal have relied on SMP access to ducts and poles as well as (in Spain) SMP access to fibre in less dense areas to foster competition outcomes across the country. Thus symmetric regulation could not be considered sufficient to support competition in these cases.

We can conclude that symmetric access coupled with BB CRD access alone is unlikely to achieve sustainable competition in retail markets for data connectivity across Europe.[254] The case of France shows that this is true, even if extensive symmetric obligations are

254 Effective competition in broadband retail markets has been found in certain EU member states in the absence of duct and pole access – notably Bulgaria and Romania. However, there are specific circumstances present in these countries including extensive application of the BB CRD in Bulgaria, that may not be relevant elsewhere.

applied that approach fibre unbundling. However, the contrasting cases of France and Spain show that the scope of SMP regulation required is affected by the type and nature of symmetric regulation required and the respective roles of each should be considered by NRAs in a coherent manner.

Before drawing final conclusions concerning the prospects for competition in markets for retail data connectivity in the absence of SMP regulation, it is necessary to consider whether new technological or market developments could lead to these markets becoming sustainably competitive in the medium term.

An important consideration in this respect concerns the prospect for 5G to enable alternative operators to provide a compelling alternative to fixed infrastructures e.g. through fixed wireless access. It is relevant to note in this context that while fixed broadband markets have been considered by most regulators to present enduring bottlenecks, mobile markets have conversely been considered to be effectively competitive, or if not (e.g. due to consolidation), have been subject to remedies under merger regulation aimed at ensuring new entry and/or effective wholesale access.[255] If the three to four mobile operators present in each country were each to provide nationwide fixed data access on the basis of their own infrastructure and spectrum resources that could potentially change the dynamics of competition in retail data markets.

Although it offers potential, 5G deployment is still at a very early stage (see section 3.1.4), and it is too soon to be able to reach conclusions as to whether such developments are likely to occur, and if so, whether they would be isolated to specific regions and countries, or would be a more general development across Europe.

Another important point is that this scenario depends on the competitive deployment of 5G and access of each party to sufficient capacity to support Gigabit services via the wireless network. However, deployment of 5G for mobile use or for FWA depends on extensive fibre deployment which may in turn require SMP duct and pole access or access to fibre for backhaul, at least for some routes.[256]

Likewise, the leverage required for operators without national fixed infrastructure to be able to negotiate access or co-investment to fibre infrastructure (for access or 5G mobile backhaul) on commercial terms, is likely to depend on those operators having deployments of their own in certain areas which can be traded against access in other areas, which is turn is likely to require SMP duct and pole access.

In some countries such as Sweden, access to the facilities needed to compete in retail data access markets and/or to deploy competitive 5G networks is widely available from alternative wholesale only (often municipal) networks. The deployment of the Open Fiber

255 See for example discussion of merger remedies in mobile markets in the context of WIK (2015b).
256 See for example, Vodafone's response to the Commission's consultation https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=60122

network in Italy should also result in the widespread availability of fibre for access and backhaul from a wholesale only supplier. However, the business model for wholesale only companies is focused on high take-up rates (i.e. high wholesale market shares) to support the utility-style business and financial model that is associated with these deployments. Even though such models may not suffer from the problems such as discrimination, associated with vertical integration, as in energy utilities, a wholesale only provider in a position of dominance in theory has the capability to raise wholesale prices above the competitive level and/or to neglect service levels and investments in the further upgrade of their networks.

Thus, we conclude that there are certain technological and market developments which might enable the market for retail data connectivity to become sustainably competitive. However, these developments depend, in the case where there are vertically integrated players, on the availability of SMP wholesale products such as duct and pole access, while in the case of markets in which wholesale only suppliers are present, on the fair conduct of those players, in circumstances where they are the primary source of wholesale supply of fibre connectivity.

Conclusion

In summary, we find that the retail market for mass-market data connectivity does not tend towards effective competition in the absence of SMP regulation.

5.1.6.2 Dedicated access segment

In principle, there should be a more favourable business case associated with deploying dedicated fibre for business purposes than for residential customers, because businesses requiring such access may have a higher willingness to pay than residential customers. The case for duplicating such fibre might also be supported by the fact that businesses with high-level requirements may prefer fully redundant capacity (i.e. fibres from separate operators). However, deploying dedicated fibre still requires significant outlays and the costs of deployment increase in less dense areas where FTTP is deployed in isolation and the distance from the exchange increases. Moreover, there are some customers which are likely to require dedicated fibre which may have lower willingness to pay, including public institutions, schools and hospitals. As these types of customer are scattered rather than focused around business zones, the business case for serving such customers may also be weaker than that associated with large businesses.

Those NRAs which have recently conducted detailed geographic analyses of dedicated access markets have found that infrastructure competition is present. However, it is generally confined to more densely populated areas, with limited choice of providers outside.[257] Analysis conducted by VVA and WIK in the context of a study to support the

257 See for example Ireland (case IE/2019/2214), Ofcom 2019 BCMR, Austria (Case AT/2018/2071), France (Case FR/2017/2032).

implementation of CEF Digital[258] also reveals that there are many schools, hospitals and other socio-economic drivers which do not have Gigabit connectivity, and where there would be high investment requirements needed to deploy the dedicated connections that they need for the medium term, supporting only one viable infrastructure or requiring subsidies to make deployment viable.

Duct and pole access made available via the Broadband Cost Reduction Directive, could help to lower entry barriers. However, as discussed in relation to mass-market broadband, the scope of these solutions is unlikely to be sufficient to deliver effective competition in dedicated access in the absence of SMP duct access and potentially downstream remedies. Indeed, we understand that SMP duct access has been used to support the deployment of dedicated fibre for business connections as well as backhaul in countries such as France, Spain and Portugal. We can reasonably expect that the degree of infrastructure competition in such services would likely be less in the absence of this intervention.

We conclude that there are high barriers to entry in the provision of dedicated high-quality access, in the absence of SMP regulation, especially in less dense areas.

As regards trends towards competition, market shares of alternative business providers may be increasing. However, this may be due to the strength of such players within competitive zones. Thus, it is not possible to obtain a true picture of trends towards competition without conducting a geographically segmented review of the market. Those NRAs which have done so, have found that although competition may have become more intense within those zones, the geographic scope of competitive zones for dedicated access has not changed significantly and there is still a significant portion of the territory in which only one option may be available.[259]

As a shared medium with lower reliability than wireline access, fixed wireless and mobile access are unlikely to be able to substitute for dedicated fibre, and thus foreseeable technological developments are unlikely to drive the market towards sustainable competition.

The entry of mass-market providers into the deployment of FTTH could provide a source of alternative supply, as such players may offer point to point FTTH or be able to deploy it alongside mass-market PON solutions. Such players could expand the coverage of areas for which competitive supply of dedicated access is available. However, the geographic coverage of mass-market infrastructure-based alternative operators (or regional or municipal providers) is still typically less than the incumbent, and thus may not address the problem in its entirety. Moreover, there are zones in which FTTH may not be viable, and mass-market connectivity may be provided via wireless solutions. However, even in these areas, it should be possible for major business and public sector customers to obtain a dedicated fibre

258 Supporting the implementation of CEF2 Digital SMART 2017/0018.
259 In Austria in fact the geographic scope of the competitive zone has remained relatively stable, covering 355 communes compared with 1,745 communes in the non-competitive zone. In Ireland, the competitive zone includes 2773 workplace zones, while the non-competitive zone includes 4446 workplace zones.

connection. Moreover, even if mass-market providers of FTTH are able to supply dedicated capacity in the areas in which they have deployed infrastructure, if they do not provide dedicated access on a wholesale basis on reasonable terms, the incumbent might still maintain an advantage for multi-site contracts, taking advantage of its ubiquity.

We conclude that there may be zones (especially less dense areas) in which there is no trend towards competition for the provision of dedicated high-quality access. The scope of these zones may vary between countries, and may be affected by the presence of municipal and alternative fibre investors as well as networks financed with the support of state aid.

In view of the enduring nature of the bottleneck for dedicated capacity in less dense areas, it is unlikely that competition law solutions would prove to be sufficient in cases where there is no competitive supply of dedicated business-grade fibre.

Conclusion

In summary, we find that the segment for dedicated access to data connectivity does not tend towards effective competition in the absence of SMP regulation, although there may be geographic variations.

5.1.7 Is there a case to segment the retail market by geography?

Competitive conditions on retail markets typically provide the starting point for geographical market analysis. The Explanatory Note of the European Commission accompanying the 2014 relevant market recommendation emphasizes that the geographical market analysis should be carried out by NRAs following a modified Greenfield approach. This implies that the competitive conditions should be considered in the absence of ex ante SMP regulation. In this context, competition between different network infrastructures, co-investment and wholesaling that would occur on a commercial basis are relevant, but competition that arises purely as a result of SMP wholesale regulation should be discounted.[260] Differences in product offerings and pricing between different regions which do occur or would occur in the absence of SMP regulation are also relevant.

When asked by BEREC in its report on the application of the Common Position on geographic aspects of market analysis most of the NRAs which started with an analysis at the retail level noted that the retail analysis was an important basis for the wholesale analysis. For example, CNMC (Spain), UKE (Poland), NMHH (Hungary) and BNetzA (Germany) identified sub-national markets concerning market 3b based on the differences in competitive market conditions that they observed at the retail level.[261]

260 European Commission (2014b); page 298; BEREC (2018c).
261 BEREC (2018c).

Table 5-3: Competitive conditions at retail level in the absence of wholesale ex-ante Regulation as a starting point of the geographical analysis of wholesale broadband markets

	Number of regulatory authorities	
	Market 3a	Market 3b
Yes	5	8
No	1	3
Other	1	1
Total	7	12

Source: BEREC (2018c).[262]

For retail high quality access markets, the number of regulatory authorities which based their geographical market analysis on an analysis of competitive conditions on retail markets is lower than in the wholesale broadband access market analyses. Four of 7 regulatory authorities opted against using competitive conditions at retail level as a starting point of their geographical analysis of wholesale high quality access markets.[263]

When the NRAs did not base the wholesale analysis on an analysis of the competitive conditions at retail level they justified it with the following reasons:[264]

- If there was no regulation, there would likely be no commercial sales of wholesale access to third parties, therefore the pattern of retail competition would resemble the pattern of competition at the wholesale level.
- The inputs provided at wholesale level (such as Ethernet services and dark fibre) are an input to any communication service and cannot be attributed to a particular retail market.

In practice, a geographic analysis of retail markets based on the modified greenfield approach is likely to take into account the same factors as those discussed in our assessment of whether the segments for mass-market data and dedicated access tend towards competition (see section 5.1.6). In the absence of any SMP regulation including duct and pole access, differences in competition in mass-market broadband are likely to be limited (and restricted for example to areas with pre-existing networks such as cable or

262 BEREC (2018c).
263 BEREC (2018c).
264 BEREC (2018c).

municipal networks), or specific areas such as Paris where there is effective access to non-SMP ducts and poles. Except in countries where there is extensive duplication of ducts by alternative providers, a modified greenfield analysis of geographic differences in mass-market broadband is unlikely to reveal geographic variations in the absence of SMP regulation (including SMP DPA).

However, in specific cases where there is infrastructure-based competition based on own/utility duct, a geographic assessment at retail level could reveal variations in competitive conditions (such as market shares and the number of ISPs) and pricing that are sufficient to warrant geographic segmentation. Although further analysis will be needed, a case in which an examination of differences in variations in competitive conditions at the retail level might be relevant is the Swedish market, noting that the VHC network presence and market position of the incumbent Telia varies between areas in which (mainly wholesale only) municipal operators have deployed FTTH networks, and areas in which they have not.[265] The Danish NRA also found in the context of its 2017 market analysis, regional differences in market shares and parallel infrastructures associated with the presence of fibre utilities in the Danish market, and is considering what implications its current plans to exclude copper from the market would have on the potential geographic segmentation of the remaining VHC market.[266]

A geographic analysis of the retail market absent any SMP regulation, may also be a useful exercise in countries in which there is extensive self-deployment of ducts and poles and/or where the Broadband Cost Reduction Directive is considered to be sufficient to avoid the need for SMP regulation of duct and pole access.

Differences in retail competition in the high bandwidth dedicated access segment in the absence of SMP regulation are also likely to be present, with some very dense areas and business districts being characterised by effective competition, while areas beyond those districts may not support more than one dedicated infrastructure in the absence of DPA. However, even within dense areas, competitive conditions may vary, and competition in those areas may still be reliant on SMP DPA or other access measures.

5.2 Relevant wholesale broadband market(s) for business and residential connectivity

We identified in section 5.1.7 that the retail market(s) for access to data for residential users and businesses are unlikely to become competitive in the absence of SMP regulation.

265 The issue of geographic variations in market shares for VHC has been raised in the context of the Commission's Serious Doubts letter concerning case SE/2019/2216.

266 Erhvervsstyrelsen (2019).

In line with the requirements of the 2018 SMP Guidelines[267] we therefore need firstly to identify the most upstream market associated with retail data provision, and assess whether SMP regulation in that market would be sufficient to address the competitive problems identified in the retail market. Thereafter, if regulation of the most upstream market is not sufficient to support sustainable competition in downstream markets, we consider whether it may be necessary to identify downstream markets as susceptible to ex ante regulation.

In this section we review current approaches to market definition and SMP analysis in wholesale markets which are relevant to mass-market and dedicated connectivity, and consider whether, going forwards, it may be relevant to identify a separate market for “physical infrastructure access”, and what might be the appropriate scope for the wholesale access market, alongside any potential wholesale markets for dedicated access.

5.2.1 Current approaches to market definition and SMP analysis in wholesale markets relevant to mass-market and high-quality broadband

The following table shows how NRAs have analysed the markets for “wholesale local access”, “wholesale central access”, and “high quality access”.

267 Para 26 in European Commission (2018b).

Table 5-4: Status of analyses of wholesale local access 2019 – selected EU member states

3a NGA review 2016-2019			AT	BE	BG	HY	CZ	FI	FR	DK	DE	EL	PL	NL	IT	PT	ES	SE	RO	UK
	year		2017	2018	2019	2019	2017/18	2018	2017	2017	2015	2016	2019	2018	2019	2017	2016	2019 (draft)	2015	2018
Associated retail market	Retail market	Includes larger businesses [y/n]?	Y	Y	N	N	N	N	Y	N	N	N	N	N	N	N	N	N		Y
		Segmented by technology [y/n]?	N	N	N	N	N	N		N	N	N	N	N	N	N	N	Y (c/f)		N
		Segmented by speed [y/n]?	N	N	N	N	N	N	✓	N	N	N	N	N	N	N	N	60MBit/s		N
Market 3a	Wholesale product market (3a)	copper	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓ (CopM)	✓	✓
		FTTC VULA	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓			✓ (CopM)		✓
		FTTH VULA	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓ (FibM)	✓	✓
		passive fibre (FTTH)	✓	✓			✓		✓	✓	✓	✓	✓		✓	✓	✓	✓ (FibM)	✓	
		ducts and poles							✓					also incl. WBA over copper, fibre and cable			✓			
		cable														✓		✓ (FibM)		✓
		fixed wireless				✓														
		mobile				✓														
	Chain of substitution	bandwidth breaks? [y/n]	N	N	N		N	N			N	N	N	N						N
	Geographic segmentation	national market? [y/n]	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y		N
		national remedies? [y/n]	Y	Y	Y	Y		N	(N)	N	Y	Y	N		N		N			N
	SMP finding	yes	✓	✓		✓	✓	✓	✓	✓	✓	✓	Y	JD	Y	✓	✓	✓		✓
		no			✓														✓	
Remedies	year							2018												
	Passive	Duct access		✓	✓		✓		✓		(✓)	✓	✓		✓	✓	✓			
		Copper LLU	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓ (CopM)		
		in-building wiring							Sym.							Sym.	Sym.			
		FTTH term. segment							Sym.				✓		✓			✓ (FibM)		
		SLU (FttC)	✓	✓			✓	✓		✓		(✓)	✓		✓					
		Dark fibre backhaul (cite F or F/M if usable for both)					✓		✓ (F/M/ bus)						✓			✓ (F)		
		Local ODF acces (FttH)		✓		✓	✓	✓	✓ (bus)	✓	✓	✓	✓	✓	✓		✓	✓ (FibM)		✓
	Active	Local access virtual-FttC	✓	✓			✓	✓		✓	✓	✓		✓	✓			✓ (CopM)		
		Local access virtual-FttH	✓	✓		✓	✓			✓		✓		✓	✓		✓			

The WLA market has been identified in nearly every case as a market for “local” access based on passive access or products viewed as functional equivalents (virtual unbundled local access), and as such NRAs have mostly distinguished WLA (3a) from the regional “bitstream” access associated with the WCA market (3b). However, the Dutch NRA concluded that WLA and WCA were substitutes and included them in the same market.

In line with approaches taken to the retail market, most NRAs have focused on analysing mass-market provision and have excluded business provision from the scope of the WLA market. However, some countries have included provision to larger businesses within the scope of the WLA market on the basis that the associated products including LLU, when offered with a high-grade SLA are provided for business use. This is particularly evident in France, where the WLA market has been defined as a “passive access” market covering physical access to copper and fibre, as well as ducts. Duct access has been mandated as remedy for SMP in WLA in most markets considered, and through a separate upstream market in the UK.

As regards the treatment of specific technologies within this market, in line with its segmentation at the retail level, Sweden has segmented the WLA market between copper (including FTTC/VDSL) and very high capacity (cable and FTTH) products. Most regulators have not considered that WLA or mobile access falls within the same market as fixed wired access. However, Croatia has included “hybrid” fixed mobile access within the relevant market. Meanwhile, most NRAs have excluded cable from the relevant market for WLA on the basis that cable technologies are not capable of offering equivalent functionality to physical unbundling. However, in countries such as the UK, cable has been included in the relevant market on the basis that it exerts indirect constraints on operators supplying virtual and physical wholesale access, while in the Netherlands cable has been included in the wider combined WLA/WCA market on the basis that cable bitstream can be provided and offers a substitute for FTTx and xDSL-based services.[268]

It should be noted that in a number of countries, including Italy, France, Sweden, and the Netherlands dark fibre backhaul has been mandated as a remedy under the WLA market, for use in conjunction with LLU, ODF access, or duct and pole access. In some cases, such as France, it has been explicitly acknowledged that dark fibre backhaul mandated as an associated facility in the context of the WLA market can also be used for mobile backhaul.

With the exception of two countries, all NRAs have found that the WLA market exhibits SMP or joint SMP (in the case of the Netherlands). However, NRAs in Poland and Italy have geographically segmented the market and concluded that there is no SMP in a portion of the national territory. It is notable however, that segmentation of NGA access remedies based on differences in competitive conditions has occurred in some countries where SMP was found in a national market. A key example is Spain. It remains to be seen if the NRA would have reached this conclusion in a potential future scenario where ducts and poles were considered separately from wholesale access, and where copper unbundling was no longer relevant or was in a separate market.

268 See discussion at section 5.2.5.3

Table 5-5: Status of analyses of wholesale central access 2019 – selected EU member states

3b NGA review 2016-2019			AT	BE	BG	HY	CZ	FI	FR	DK	DE	EL	PL	NL	IT	PT	ES	SE	RO	UK
Market 3b (ex market 5)	year		2017	2018	2015	2019	2017/18	2017/18	2017	2017	2015 (s.o.)	2016	2019		2019	2016	2016	2015	2015	2018
Associated retail market	Retail market	Includes larger businesses [y/n]?	Y	Y	N		N	N	Y	N	Y	N	N	Deregulated since 2012 but regulated in the context of single wholesale broadband access market from 2018	N	see 2008	N	N		N
		Segmented by technology [y/n]?	N	Y	Y	N	N	N	N	N	N	N	N		N		N	N		N
		Segmented by speed [y/n]?	N	N	N	N	N	N	N	N	N	N	N		N		N	N		N
Market 3b (ex market 5)	Relevant product market	copper	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓		✓
		FTTC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓		✓
		FTTH	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓		✓
		cable		✓		✓			✓	✓	✓							✓		✓
		fixed wireless								✓					✓					
		mobile				✓														
	Chain of substitution	bandwidth breaks? [y/n]	N	N	N	N	N	N		N	Y	N	N	see market 3a	N		N			N
	Geographic segmentation	national market? [y/n]	Y	Y/N	Y	Y	Y	N	✓	Y	✓	Y	N		N		N	✓		N
		national remedies? [y/n]	Y	Y/N		Y	Y	N		N		Y	N		N		N			N
	SMP finding	yes	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓		✓			✓
		no			✓													✓	✓	
	Active	WBA-Copper	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓		✓			✓
		WBA-FttC	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓		✓			✓
		WBA-FttH	✓			✓	✓	✓		✓		✓	✓	✓	✓					✓
		WBA-Cable		✓		✓								✓						

The table above provides an overview of the results of market analyses in the market for wholesale central access (market 3b). This market has been found to be effectively competitive or not meriting regulation[269] on a nationwide basis in four countries, while in another four regulation is applied only in areas where competition on the basis of WLA remedies was found to be insufficient to promote effective competition at the retail level. The scope of the WCA market subject to regulation has in particular decreased significantly, such that less than 1% of UK premises are in the portion of the market deemed to be uncompetitive.

In some other countries, such as Belgium and Germany, regulation has persisted in this market because this market (rather than WLA) has been the main market in which the key NGA bitstream access products have been mandated. This market has also been regulated in countries where SMP operators operate cable networks (such as Belgium, Netherlands and Denmark). In these cases, the attention on WCA rather than WLA has largely resulted from the conclusion that the relevant cable and/or FTTC-based wholesale products should be characterised as “bitstream” and could not meet the relevant criteria for “virtual unbundled local access”. In two countries, bitstream access has oscillated between deregulation and reregulation, based on the inclusion or exclusion of mobile broadband in the market (in the case of Austria) or the inclusion or exclusion of cable in the market (Netherlands).

In general it can be said that there appears to be a greater trend towards competition in the WCA market than on the upstream WLA market, and that in markets where it has been found not to be effectively competitive on a regional or national basis, a key reason may have been the respective definitions of the WLA and WCA market and interpretation of what is meant by “virtual unbundled access”.[270]

269 The market is not regulated in Portugal.

270 Although in the 2014 Recommendation on relevant markets, it is recommended to include virtual access meeting certain criteria in the same relevant market as physical unbundling in the WLA market, not all NRAs have considered that the bitstream offers made available in their jurisdictions meet the required characteristics for them to be considered substitutable for physical unbundling.

Table 5-6: Status of analyses of wholesale high quality access 2019 – selected EU member states

Market 4 review 2014-2019 (most recent)		AT	BE	BG	CZ	FR	DK	DE	EL	PL	NL	IT	PT	ES	SE	RO	UK
year		2018	2013	2016	2017	2017	2016	2016	NA (2013)	2015	2016	2015	2016	2016	2016	2018	2019
Combined with M3a/3b review? [y/n]		Y				Y	N	N			N	N	N	Y	N		N
Associated retail market	Includes business "bitstream" [y/n]?	N	N	N		Y	N	N			N	N	N	N	Y	deregulated	N
	Segmented by technology [y/n]?	N	N	N	N	N	N	N			N	N	N	N	N		N
	Segmented by speed [y/n]?	Y	N	N	Y	N	N	Y			N	N		N	N		N
Relevant wholesale product market	traditional LL		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓
	Ethernet based LL	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓
	Optical LL (native Ethernet?)										✓						✓
	Ducts and poles																✓
	Business bitstream					✓					✓		✓	✓	✓		
	Dark Fibre	✓									✓						
Network segment	Backhaul included? [y/n]	Y		N													Y
Chain of substitution	Bandwith segmentation	✓			✓			✓	✓	✓		(✓)	24M				
	Technology segmentation												✓				✓
Relevant geographic market	national	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		
	sub-national	✓											✓				✓
SMP finding	yes	✓	✓		✓	✓		✓	✓	✓	✓	(✓)	(✓)	✓			✓
	no						✓								✓		
Remedies	traditional LL		✓		✓	✓		✓	✓	✓	✓	✓	✓	✓			✓
	Ethernet based LL	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓			✓
	Optical LL																
	High Quality WBA					✓				✓			✓	✓			
	Duct and pole access																
	Dark fibre access	✓															✓

The table above provides an overview of the approaches taken towards the definition of the high quality access market (market 4) in selected EU member states. A key finding is that those countries which found that there was competitive supply of services for mass-market broadband (Bulgaria and Romania) have also found that the business market was competitively supplied. In addition, two of the Nordic countries have found effective competition in this market, inter alia based on the availability of fibre connectivity from specialist suppliers and /or municipal networks. A significant number of other NRAs (6 from our sample of 16) have segmented the market by speed (a potential proxy for legacy vs fibre-based business services) or geography and found that the competitive conditions varied, with more competition found for higher speed (fibre-based) services and/or leased line services offered outside business districts.

Following the guidelines elaborated in the 2014 Recommendation on Relevant Markets, business-grade bitstream has been considered to provide a substitute for dedicated business-grade products in a number of markets, including France, Spain and Portugal. The availability of mass-market fibre connectivity and prevalence of point to multi-point FTTH business offers in these countries may have contributed to this conclusion.

Lastly, it is notable that two NRAs (those in Austria and the UK) have specifically considered competitive conditions for fixed and mobile backhaul in this market (rather than as an associated facility to market 3a). The same NRAs have considered it important to include within the relevant market and/or mandate dark fibre access as a solution to perceived challenges in this area.

5.2.2 Is there a separate physical infrastructure access market?

Access to ducts and poles and associated infrastructure is the most upstream service that could contribute to the development of infrastructure competition in retail data.

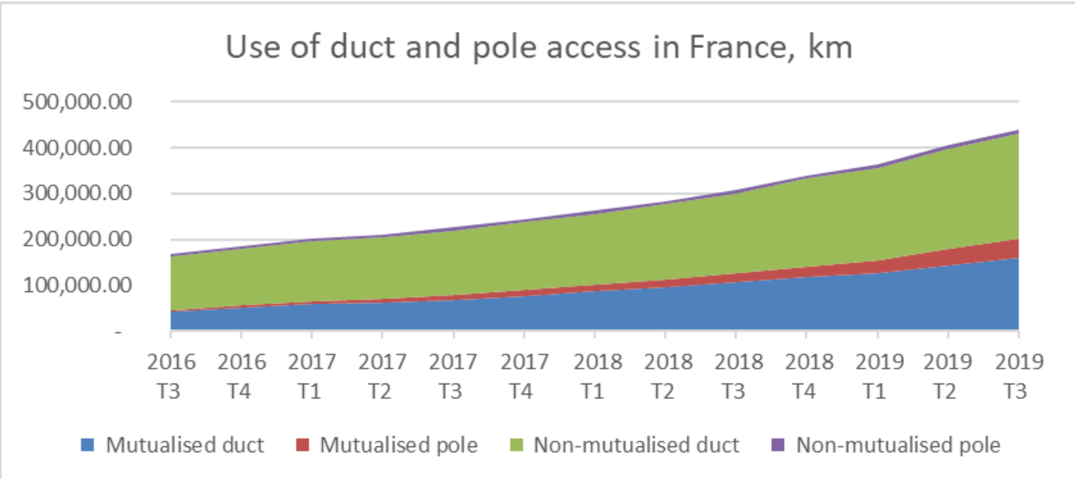
Access to ducts and poles can be seen as a "cross-market" wholesale remedy in that it can be used to facilitate the deployment of fixed access infrastructure to consumers as well as businesses and (if applied in the relevant network segments) for fixed and mobile backhaul as well as access.

The summary of approaches across Europe shows that duct and pole access has been mandated under SMP regulation in the majority of countries considered.

Its use is also expanding according to data from those NRAs which provided it.

For example, published data from France (see following chart) shows expanding of both SMP duct (and to a lesser degree pole) access, both in the "mutualized" segment (where deployment is expected to lead to new connections to homes and businesses) and in the non-mutualised segment and for business access purposes.

Figure 5-9: Use of duct and pole access in France, km



Source: ARCEP observatory

Meanwhile confidential data provided to the study team in October 2019 shows increasing use in some other countries, although there is evidence of stabilizing use in countries such as Spain, Portugal and Latvia and Estonia, where fibre deployment is already well progressed.

PIA has traditionally been mandated as a remedy in the context of the wholesale local access market, or included in a wider market as a substitute for other forms of wholesale physical access (in France). However, in recent years, this approach has been challenged with decisions in the UK, and a proposal in France, to identify PIA as a market in its own right.

The UK case

In June 2019, the UK NRA Ofcom defined a separate product market for the supply of wholesale access to telecoms physical infrastructure for deploying a telecoms network.[271]

Ofcom justified its focus on physical infrastructure on the basis that it was preferable to intervene in the most upstream market possible, that the deployment of FTTH offered the potential to encourage greater network competition, and also cited provisions in the Code that suggest that access to physical infrastructure should be considered as a remedy, before assessing the need to impose any other potential remedies.[272]

Although Ofcom had previously imposed duct and pole access as remedy within the wholesale local access market, they considered that it was more robust to conduct market analysis at the level of value chain corresponding to the level of intervention. An advantage of this approach would be that they could consider the implications of conduct in the physical infrastructure market on the two existing downstream markets (WLA and business connectivity), as well as other markets that might emerge. Ultimately, the separation of the physical infrastructure access market could facilitate deregulation of downstream markets. Conversely, Ofcom observed that if duct and pole access continued to be treated as a remedy, this may have the perverse effect that the WLA market might be found to be competitive, but only as a result of a remedy that was applied within that market itself.

The scope of the market includes networks that can be used to host fixed elements of telecoms networks, such as ducts, poles and chambers, regardless of whether they are used for access or backhaul. Non-telecoms infrastructure was excluded from the market. Ofcom observed that non-telecoms infrastructure was currently used to host telecoms networks, but this use was very limited in scale and had led to only very limited network rollout in the UK. Ofcom also noted that non-telecoms physical infrastructure has material disadvantages, in terms of costs and operational complexity that would render switching from telecoms physical infrastructure to non-telecoms physical infrastructure unprofitable and therefore unlikely.[273] Ofcom also considered, but rejected the potential for wireless and mobile networks to act as a constraint on networks installed within physical access infrastructure.

271 Ofcom (2019).
272 Recital 187 in European Parilament (2014).
273 The higher costs and operational complexity is mainly due to the following reasons: (i) lack of sufficient access points, (ii) restrictive rules for access (in particular for water, gas and electricity physical infrastructure), (iii) unsuitable network design, (iv) hostile environment for network coexistence (sewers), (v) lack of suitable sites for hosting technical facilities, (vi) high costs due to contractual complexities and costs related to the need to deploy cable ducts for telecoms physical infrastructure inside the non-telecoms infrastructures.

Contrary to its previous approach towards duct and pole access regulation in which the use of DPA had been linked to the deployment of mass-market broadband services, Ofcom did not seek to identify specific use cases associated with the use of ducts and poles, or to distinguish between the use of ducts for access and backhaul. Rather Ofcom noted that “we do not think this would be practical or desirable because we cannot predict the full range of potential access seekers which may emerge in future, both in terms of the downstream services provided over that network, and the network architectures they desire. Moreover, an approach which involved defining a product market (or number of product markets) in relation to stylised use cases we can identify today could result in remedies which artificially restrict innovation and lock access seekers into existing markets and network topologies. This would fail to address the full extent of the market power arising from control of access to physical infrastructure.”[274] The open-ended use of DPA is similar to the approach pursued by the NRA in Portugal, but contrasts with approaches taken by some NRAs, which have restricted the use of SMP duct and pole access to the “access network” or in the case of Germany to backhaul associated with SLU.[275]

When considering the relevance of identifying a separate market for the purposes of the list of Relevant Markets Susceptible to ex ante regulation, it is necessary to take into account a number of factors:

i. Whether the principle established by Ofcom is sound i.e. that it is appropriate to analyse the market at the level at which regulation takes place; and if so

ii. Whether the market identified by Ofcom is relevant for majority of EU member states; and if so

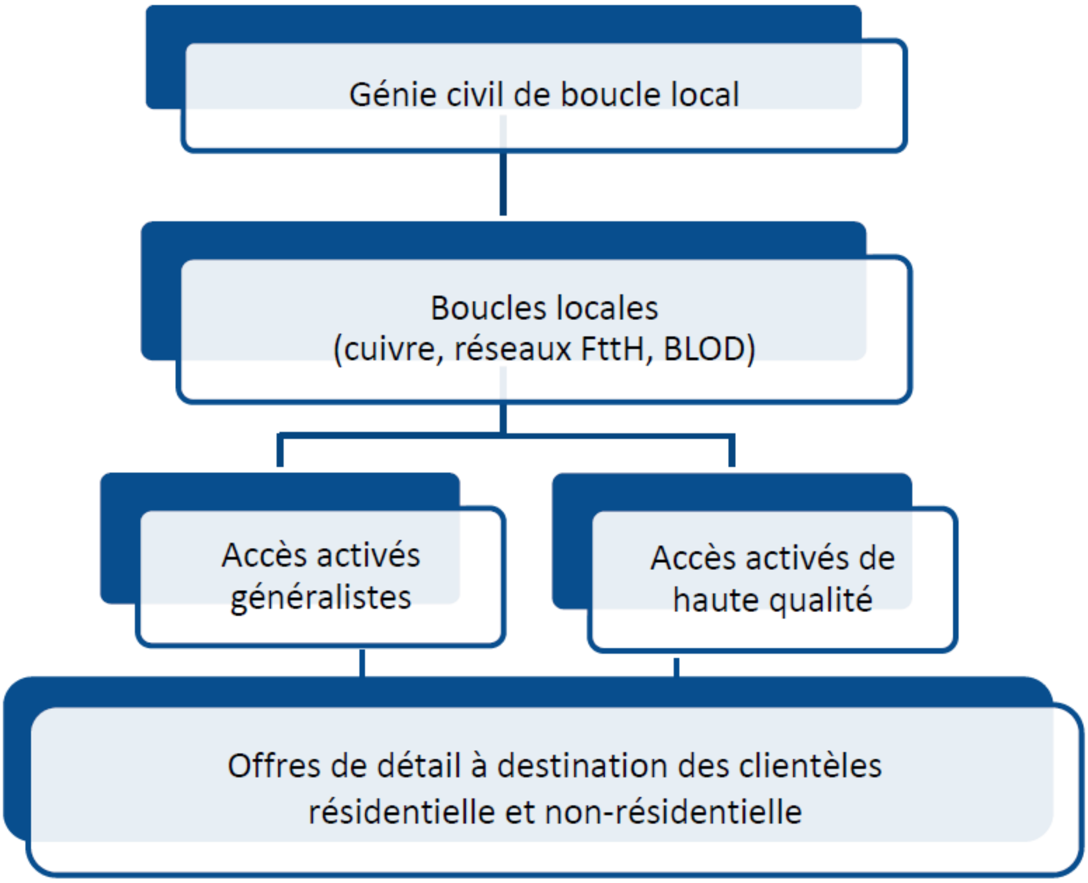
iii. Whether, at an EU-level, there are constraints applying to this market that would imply that additional wholesale products should be taken into account

France

In its draft analysis of the market for physical infrastructure access, ARCEP notes, similarly to Ofcom that the market for physical infrastructure access is upstream from the wholesale local access and business connectivity markets (markets 3a and 4). The value chain, and the relationship of ducts and poles to downstream product markets, is shown in the following diagram. ARCEP notes that the deployment of fibre connections, which are replacing copper connections, are difficult to realise in the absence of access to ducts and poles.[276]

274 Para 3.45 in Ofcom (2019).
275 See benchmarking of approaches in WIK (2017).
276 Para 2.1.2 ARCEP Consultation on proposed PIA market 2020

Figure 5-10: Structure of the fixed market value chain, according to ARCEP



Source: ARCEP consultation on PIA market 2020

ARCEP concludes that the market includes both telecoms aerial infrastructure and ducts, as these are used for the same purpose and are required in tandem for the deployment of fibre optic networks. Like Ofcom, ARCEP concludes that utility ducts, such as those available in the sewers of Paris and certain other areas, do not provide a substitute for telecom ducts. ARCEP notes in this context that sewers were used by operators at a time before the availability of duct and pole access from Orange, and that such access is subject to constraints arising from saturation of certain segments, security requirements and risks, which raise costs in comparison with the use of telecom ducts. ARCEP observed that some operators that had initially pursued a strategy of using sewers for deployment, had adjusted their approach to using Orange ducts in Paris. ARCEP also concludes that access to other utility networks does not substitute for access to telecom duct and pole infrastructure, inter alia because power cables have been installed in the ground without ducting, while district heating networks are not suitable due to temperature and leakage constraints. Meanwhile, ARCEP observes that it is difficult to install fibre within water and gas networks due to the presence of valves, while rail and motorway networks lack the necessary capillarity for the deployment of electronic communications networks. ARCEP concludes on this basis that there a market for electronic communications ducts and poles, which excludes facilities from other sectors.

Principle

Ofcom raises an important point of principle, which is that if analysis of a wholesale market does not take place at the network level which is intended to be subject to regulation, and the upstream remedy turns out to be the key factor which promotes competition in that market, the market cannot readily be analysed following the modified greenfield approach, or deregulated once the remedy has successfully supported competition in that market.

Taken together with the principle, established in the EU electronic communications Code, that duct and pole access is likely to be a core remedy (and potentially in time the only remedy)[277] supporting competition in some electronic communication markets, there appears to be a case that duct and pole access should be assessed separately from downstream markets and remedies, where duct and pole access mandated on the basis of SMP (as opposed for example to utility ducts or self-construction by utility companies or municipalities) is likely to be a key driver for infrastructure competition in downstream markets and the entry of new players in different regions.

Where relevant for downstream competition, the fact that duct and pole access is a “neutral” product which can be used for multiple purposes, as noted by both Ofcom and ARCEP, also supports the case to analyse it separately from downstream markets which may be more closely associated with particular retail services or service segments.

Another factor supporting its identification as a separate market is that the boundaries of this product market are likely to be stable over time, given the need for any fixed infrastructure to be housed in ducts or transported aerially, for at least part of its route.[278]

Relevance

Although the principle of identifying duct and pole access as a distinct market appears sound in markets where PIA mandated on the SMP operator is likely to be a key means of supporting infrastructure competition and entry, a review of approaches taken across Europe suggests that SMP PIA has not been considered by NRAs to be relevant in all cases.

For example, a review of remedies under market 3a within 18 EU countries (see Table 5-4) shows that competition problems were found and SMP duct access was mandated in 10

277 This can be inferred from the provisions which require NRAs to assess the sufficiency of physical infrastructure access before other remedies are applied, as well as practical approaches taken in countries such as Portugal that have placed their entire focus on duct and pole access as a means of supporting competition in broadband services.

278 In some countries, such as Spain and Belguim, façade cabling is common in dense housing districts. This may obviate the need for cables to be housed underground or on poles, for some of its route. However, cables are still likely to be buried or housed in ducts or carried on poles for a portion of their route.

countries including the UK. However, in total, there were 6 countries from the 18 analysed which found that the WLA market lacked competition and mandated some form of wholesale fixed access, but not PIA. Different reasons were given. In Sweden PIA was previously mandated in a decision taken in 2015,[279] but PTS proposed in 2019 to remove the obligation on the basis that PIA cases could be handled instead in the context of the BB CRD.[280] It should also be noted that the country as a whole is characterized by the widespread presence of municipal wholesale only point to point fibre networks, suitable for residential and business use, which are likely to have reduced the demand for duct and pole access. Duct access was not mandated in the Netherlands due to the practice of directly burying cables in the ground, and is only mandated in the feeder section of the access network in Germany on the basis that the obligation was associated with other obligations aimed at promoting competition in broadband services i.e. SLU. The lack of an available uniform solution based on incumbent PIA in Germany and the fact that cables are often directly buried in the drop segment, has led operators also to focus on other forms of PIA including utility-based PIA, as can be seen in the number of disputes raised on this matter under the BB CRD.[281]

There are also two countries in which the WLA was found to be competitive, and therefore no remedies were applied. In Bulgaria, SMP duct and pole access was previously mandated, but the obligation was withdrawn in 2019 in light of analysis which suggested that alternative operators were constructing and expanding their own duct and pole networks, that the broadband Cost Reduction Directive could provide an effective alternative regulatory solution to SMP regulation, and that the market as a whole was effectively competitive.[282] Likewise, in Romania, the NRA concluded in 2015 that the market was effectively competitive in the absence of SMP duct and pole access (or other access remedies).

As regards take-up, few NRAs from those responding to the questionnaire provided data on take-up of SMP duct and pole access. However, significant and/or expanding take-up can be seen[283] in Spain, Portugal, Italy, Ireland, and France. Some degree of usage was also reported in Latvia, Estonia and Bulgaria. A high degree of interest is present in the UK.

It is possible that duct and pole access is used but was not reported for some of the countries. It could also become relevant in additional markets, where it is not used today, if action is taken to effectively implement SMP duct and pole access regulation. However, it still seems likely that SMP duct and pole access may not be a relevant solution for all countries in which a competition problem has been identified in fixed data connectivity.

279 See Case SE/2015/1687.
280 PTS 2019 Draft decision on market for local access to fibre networks
281 See WIK (2018c).
282 See Case BG/2019/20155.
283 Based on responses to a questionnaire circulated October 2019 as well as data published on NRA websites

Constraints on physical infrastructure access at an EU level

If we take as our focal point, Ofcom's (and ARCEP's proposed) relatively narrow definition of the potential market as physical infrastructure operated by telecom providers that is used to host telecom infrastructure, we need to consider potential constraints to this access product that could result in a wider market at EU level.

A first question is whether non-telecoms infrastructure such as that voluntarily provided by utility companies or mandated via the BB CRD provides a constraint for duct and pole access operated by telecom companies. As noted in section 5.1.6.1, we are aware of a number of countries in which utility poles in particular have been used to support rural deployment. A key example is Portugal. Italy and France also report significant use of utility infrastructure (see Figure 5-5), and there is a high degree of interest in municipal and utility infrastructure in Germany, as evidenced by the number of disputes brought on this subject under the BB CRD.

However, as noted by both ARCEP and Ofcom, there are some limitations to utility infrastructure (including security, location and regional fragmentation) which would tend to make it more cumbersome than using access to telecom infrastructure deployed by a company with extensive coverage. The terms and conditions may also be less favourable, since the BB CRD envisages dispute-based intervention rather than ex ante intervention, and best practice approaches are only beginning to be developed.[284] Where there has been significant interest and reliance on utility infrastructure, this may also be due to the absence of effective telecom PIA in the network segments where it is most important in reducing cost. In other words, there may be a path dependency, whereby network investors seek other (less optimal) solutions, when telecom PIA is not effectively available across the access network.

We also note that in practice SMP duct access has been the primary access mechanism for access to ducts in those countries which reported data. Where operators have already installed their infrastructure in the ducts of SMP operators, switching cables to an alternative physical duct infrastructure in the same location would not be realistic, while switching to alternative duct infrastructure for further deployment would be significantly more complex than remaining in the current system. In these cases, by virtue of the significant sunk costs that have been incurred by the network investor, the owner of the PIA in which the infrastructure is housed, would likely have the potential and (given its presence in downstream markets competing with the investing entrant) the incentive to raise the price for PIA in the absence of regulation. Thus, in practice, duct and pole access under the BB CRD is unlikely to provide an effective constraint for SMP duct access, especially bearing in mind the reactive and case-by-case nature of the current BB CRD.

284 See the WIK (2018c)

An assessment of the potential constraint from wireless and mobile infrastructure is likely to follow the logic of our earlier assessment of the degree to which wireless and mobile networks could substitute for fixed access and backhaul (see section 5.1.3). In summary, for the moment, we do not see that these technologies provide functional equivalence for the fibre infrastructure that would be laid in ducts and poles. It is possible that this may change with the deployment of 5G FWA. However, the impact of this technology is not yet clear, and moreover, competitive deployment of 5G requires installation of a dense fibre backhaul network, which is likely to require duct and pole access. Thus, we conclude that wireless and mobile technologies are unlikely to present a constraint to physical infrastructure used to house telecom networks.

A more difficult question is whether the physical infrastructure used to house telecom cables may substitute for access to those cables. Although it now proposes to change this approach, the French NRA ARCEP previously included telecom ducts and poles within the market definition for wholesale local (physical) access, implying that it could substitute for unbundled access.[285]

Other evidence for the potential for VHC access to substitute for physical infrastructure access comes from the provisions of the BB CRD,[286] whereby operators may be exempted from symmetric duct and pole access obligations if they make available a viable alternative means of wholesale physical network infrastructure access, provided such access is offered under fair and reasonable terms and conditions. A number of regulators have also implemented provisions whereby dark fibre backhaul must be provided by SMP operators in circumstances where duct access is not available.

There may thus be a choice to be made by operators deploying a new network, as to whether to buy wholesale access or build it with the support of PIA. However, it should be noted that operators which have already deployed their own infrastructure on the basis of duct and pole access would not be able to readily switch from PIA to using access in the event of a price increase in PIA, as this would entail stranding of their existing assets. Conversely, operators which have reached long-term co-investment arrangements to enable them to access fibre infrastructure would not be in a position to switch to deploying their own infrastructure, although those which had short term rental agreements might be able to do so.

It is also relevant to consider what kind of fibre access might present a functional substitute to duct and pole access from the perspective of an access seeker. Whereas duct and pole access enables the deployment of infrastructure in a manner that allows full control by the access seeker over the architecture, materials and active equipment applied on their network, unless provided on the basis of dark fibre, access to fibre e.g. in the form of VULA, bitstream or leased lines, may impose limitations that restrict the access seeker's ability to

285 ARCEP (2017).
286 BB CRD article 3 in European Parliament (2014).

innovate as regards network design and the installation of active equipment as well as limiting their flexibility as regards bandwidth, quality or service levels. Some wholesale services may also be targeted towards specific use cases, thereby limiting the opportunity for the access seeker to deploy infrastructure for multiple purposes. It is relevant to note in this context that in its 2017 WLA market review, ARCEP included duct and pole access within a relevant market that was focused on 'physical' infrastructure – and did not conclude that it could substitute for virtual or active access. Moreover, with the increased reliance on PIA to deploy infrastructure for multiple purposes in France, ARCEP proposed in 2020 to entirely separate the PIA market from downstream infrastructure.

Consultation responses

Respondents to the Commission's consultation had varying views on whether duct and pole access should be identified as a separate market.

Stakeholders responding to the EC consultation had mixed views on whether a separate duct and pole access market should be defined. Whereas companies such as Orange, COLT, PT and Vodafone favoured the identification of such a market on the basis that ducts and poles are a key component in supporting infrastructure competition and that separation of this market was needed to enable the effects of this remedy to be considered distinctly from local access, others argued against this approach on the basis that duct and pole access was or could be better handled via the BB CRD, and/or that article 72 of the Code provided a "work-around" to the challenge of imposing duct access as a remedy in markets which were defined in relation to other wholesale products. Regional operators and some business operators deploying infrastructure via their own duct and pole infrastructures such as Dansk Energi, BREKO and Eurofiber were particularly opposed to the identification of ducts and poles as a distinct market, as they were concerned that their duct and pole networks might be captured within the SMP regulatory regime, or that a more intense focus on PIA regulation in general could lead to "cherry-picking" of certain customers or connections within their service area undermining their business case for the deployment of fibre.

The FTTH Council also concluded that access to PIA is already addressed through other mechanisms including the BB CRD, and thus the third pillar of the 3 criteria test would not be met. This view was echoed by ETNO. ECTA also considered that it would be counterproductive to single out the PIA remedy to create a separate market as because of the variation in approaches currently taken by NRAs regarding passive infrastructure. Liberty Global noted that, in view of the fact that the European Commission plans to review the BB CRD, it was premature to conclude that the BB CRD would not be able to address concerns regarding access to physical infrastructure. According to Liberty Global it was also be necessary to wait to see how recent amendments to the Code, namely article 61, will be implemented in Member States and what effect they have on the market.

As regards the potential use of utility infrastructure, some operators such as 1&1 Versatel observed that they used infrastructures from both telecom and other network operators such as gas and water. Eurofiber also considered utility infrastructure to be relevant for access seekers. However, COLT observed that ducts and poles from other utilities were rarely suitable to host telecom infrastructures, and Liberty Global also did not consider ducts and poles from other utilities to be substitutable for telecoms PIA, although some infrastructure might be more suitable than others.

Conclusions

Based on an analysis of the characteristics and capabilities of different wholesale product offerings, we conclude that there may, in some cases, be a distinct market for physical infrastructure access provided by telecom operators. This is a product market that is upstream of both the current markets 3a/b and 4, and could in principle be used for multiple purposes. There may be a distinct PIA market, in particular, in countries in which there is a ubiquitous or wide-reaching network from a single player that is suitable for the deployment of alternative infrastructure and where this infrastructure is or could be the primary mechanism through which infrastructure competition and new entry in VHC broadband can be promoted. Evidence of usage patterns and constraints associated with utility PIA suggests that in countries where such a comprehensive telecom duct and pole infrastructure exists , utility physical infrastructure is unlikely to provide a direct substitute, due to differing standards and locations of the networks, as well as the cost and complexity involved in using multiple PIA systems. Although dark fibre may substitute for PIA for operators which have not yet deployed their network, virtual and active access products such as VULA and bitstream are unlikely to substitute for PIA due to the limited flexibility these products offer. Wireless and mobile connectivity are unlikely to provide a constraint on telecom PIA and may indeed rely on PIA for fixed connections to base stations.

Where PIA has led to significant entry, definition of a separate PIA market will ultimately be necessary to ensure that the distinct SMP characteristics of PIA and downstream markets (which may have different SMP operators or competitive characteristics) can be appropriately assessed. In the shorter term, in the period while infrastructure-based competition is emerging and/or where it is unclear whether PIA will play a significant role in driving infrastructure based competition and new entry, other approaches could be considered, including mandating PIA as a remedy.

Alternative approaches to defining a separate market for PIA in the context of SMP analysis may also be suitable in the longer term in countries where the supply or demand-side conditions mean a separate PIA market cannot be clearly defined or distinguished. For example, in some countries telecoms networks have been directly buried in some or all parts of the access network, which limits supply. In turn, in such cases, the lack of a complete telecom PIA infrastructure may prompt potential investors to seek access to alternative infrastructures including utility PIA, even though this may be a suboptimal solution. In other cases where point to point fibre unbundling (dark fibre) is readily available across a wide portion of the country,[287] demand for PIA as a distinct product may be limited.

In these cases, it may be appropriate to mandate PIA as a remedy within the downstream market (where it is used in a more limited fashion and/or to supplement other forms of access) and/or focus on enforcing PIA under the BB CRD (where access to utility infrastructure is important).

More generally, where there is a lack of accessible telecoms PIA due to direct burying of cables for historic or strategic reasons,[288] this is likely to raise costs for the upgrade of networks and undermine prospects for infrastructure competition. This raises questions about whether there may be a case for requirements to deploy ducts, with sufficient capacity for potential use by alternative operators (in cases where network duplication could be viable), as a condition of granting rights of way for the deployment of telecom networks.

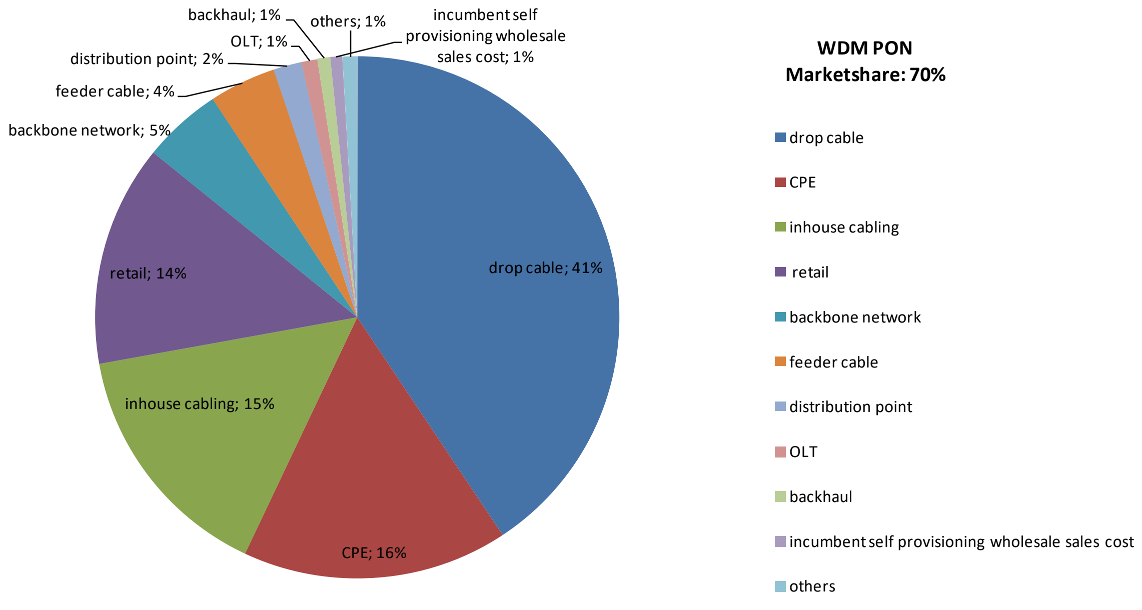
5.2.3 Does the PIA market meet the 3 criteria test?

High barriers to entry

Cost models prepared by WIK and others illustrate that a very high proportion of the upfront cost associated with deploying fixed infrastructure is associated with civil works. This can range from 50-80% or more. As such civil infrastructure presents very high barriers to entry and replication.

287 This situation is uncommon in Europe, but may be present for example in countries such as Sweden where dark fibre is available from municipalities across a significant portion of the country.
288 Operators may have an incentive not to duct their networks, or to provide insufficient space within the ducts to accommodate other players, in order to avoid overbuild.

Figure 5-11: Share of costs associated with FTTH infrastructure deployment



Source: WIK

This is also evidenced by the limited degree to which telecoms infrastructure has been replicated in areas where duct and pole access is not available as discussed in our greenfield analysis of the retail market (see section 5.1.6.1), and the fact that even with duct access, replication in fixed access networks has still typically been confined to more densely populated areas (see Table 3-2). This suggests that, for cases where a separate PIA market is relevant, the first criterion is met.

Limited tendency towards competition

Moreover, the cost drivers for civil infrastructure (based largely on labour and construction equipment) are stable or even increasing, which means that this market is not likely to tend towards competition in the medium term. As regards potential technological developments, techniques such as micro-trenching may reduce costs compared with traditional trenching approaches. However, it is worth noting that operators such as Cityfibre which have used microtrenching techniques, still consider that effective remedies for duct and pole access are required to support scale roll-out of FTTP.[289] Wireless technologies could provide an alternative access solution that avoids the need to bury cables or construct extensive pole networks in rural areas. However, as discussed in section 5.1.3, wireless access is not expected to provide an extensive substitute for fixed access, with the possible exception of remote and rural areas, where network duplication, even of the backhaul required for wireless connectivity may be challenging.[290] In such rural areas PIA (likely pole access)

289 See for example Cityfibre (2017).
290 Ecorys et al. (2020).

may be needed to support the deployment of FWA, and thus is not a substitute. Thus, where it is relevant to identify a separate market for telecoms PIA, this market would meet the second criterion.

Insufficiency of competition law or other solutions

Effective implementation of SMP duct and pole access typically requires the extensive involvement of the NRA to guide terms and conditions and ensure that the price is effectively cost-oriented.[291] This type of intensive ex ante intervention makes duct and pole access an unsuitable remedy to be addressed via competition law.

Symmetric regulation of telecoms PIA is possible under the BB CRD, and could obviate the need for SMP PIA regulation, if it is capable of performing a similar role. However, the provisions of the current BB CRD are not conducive to the application of the Directive for access to telecoms ducts and poles, inter alia because they envisage an ex post “dispute-based” approach to access regulation, and the Directive does not contain all the provisions that are typically necessary to ensure effective access to incumbent PIA infrastructure and monitor its effectiveness over time. [292] It is possible that changes could be made to strengthen the PIA provisions in the context of the Review of the Broadband Cost Reduction Directive. However, the implementation of such a change would be likely to take a number of years, and strengthening provisions in symmetric legislation could have the effect of creating undue burdens on operators which do not have SMP, or (if strict obligations are made conditional on the market position of specific operators), replicating the asymmetric regulatory regime.

A further alternative to the identification of PIA as a separate market is to mandate PIA as a remedy in the context of one or more other markets that have been found to be susceptible to ex ante regulation in line with article 72 of the EU Electronic Communications Code. Under this provision, NRAs may impose obligations to provide PIA irrespective of whether the assets that are affected by the obligation are part of the relevant market in accordance with the market analysis, provided that the obligation is necessary and proportionate to meet the objectives of fostering very high capacity network deployment and take-up, competition and end-user needs. PIA regulation has in practice been implemented in most countries through this mechanism, as NRAs have mandated PIA as a remedy in the context of the WLA market, even though it has not typically been included within the market definition (with the exception of France and Spain) and can be used for services other than those envisaged as covered by the WLA market. Experience to date, suggests that this approach can be effective in implementing PIA, and could obviate the need for a separate market to be

291 Details of the types of regulatory intervention required, are described in the WIK (2017d).
292 In addition, the BB CRD includes provisions that suggest that where an operator providing VHC is obliged to offer PIA, the impact on the business case should be taken into account – see Recital 19 BB CRD in European Parliament (2014). This may not affect pricing outcomes in cases where ducts have been installed in the distant past and are fully depreciated, but adds an additional consideration that would not normally be applied in the case of regulation of an SMP operator, where the object of regulation is to promote competition including by ensuring that it is possible to duplicate the network of a dominant firm.

identified. However, challenges may arise in countries where SMP PIA is a key remedy in promoting infrastructure competition..

- Reliance on SMP PIA as a remedy would not be effective in cases where SMP PIA is (or becomes in future) the only SMP remedy required to ensure effective competition in telecommunication markets, as it necessitates a finding of SMP in at least one market that is downstream of PIA. This issue was raised in Ofcom's analysis. It could also become a relevant consideration for NRAs such as ARCEP in France, which have pursued symmetric regulation as an alternative to SMP regulation of VHC (and potentially dedicated) access.
- Where PIA is effective in stimulating deployment by alternative investors, relying on PIA as a remedy could lead to a mismatch in the geographic scope of PIA obligations (which may need to be nationwide) and the geographic scope of downstream markets for broadband access, which may be subnational, due to the emergence of infrastructure competition in some areas (warranting a no SMP designation), and/or the deployment of VHC infrastructure by an operator other than the incumbent, which may warrant an SMP finding e.g. in the context of state aid or in other areas where only one VHC network is economically viable. NRAs may seek to circumvent this anomaly by defining downstream VHC or dedicated access markets as national (due to their reliance on a nationwide PIA remedy). Indeed, today WLA markets have mainly been defined on a nationwide basis, in part due to the ubiquity of incumbent PIA and copper. However, this may not accurately characterize the competitive conditions of VHC markets, and may risk over or under-regulation, as variations in regulation of VHC or dedicated access would be based on geographic variations in remedies rather than geographic variations in the underlying scope of the relevant market.

This means that, in cases where SMP PIA is a key remedy supporting infrastructure competition, PIA will need – once the remedy is well-established and its use widespread – to be defined as a separate market, particularly when copper switch-off has started.

As regards the potential application of competition law, various access requests to ducts and poles have all been rejected in a series of actions brought before various EU and EFTA States, including Iceland, the UK, Romania, Ireland and Italy. The rationale for the rejection of competition claims has been varied, but suggests that there are residual difficulties in applying competition rules where market definition is unclear, where the owner's knowledge of the specific infrastructure is often not detailed, where the actual costs of providing access are elusive, where the results of such mandated access might lead to the inefficient duplication of infrastructure, and where the relative efficiency of the infrastructure may be unknown.

A second reason why competition rules may be ineffective is because an existing piece of legislation, in the form of the Broadband Cost Reduction Directive, could in principle govern access relationships which might otherwise be addressed under competition rules. Yet, under the terms of that Directive, Recital 15 provides infrastructure owners with a significant basis upon which to deny access if that would result in “prejudice to the future business interests of the infrastructure owners”. The breadth of this exception has been widely cited by infrastructure owners as a means legitimately to deny access requests. In the presence of such an express regulatory exception to the granting of access to telecom ducts, it may make it more difficult to argue that competition rules should override access denials to ducts and poles.

Another reason why it is difficult to use competition rules to mandate access to ducts and poles is the fact that access to an incumbent telecommunications operator’s network assets in the absence of a specific market for PIA is typically regulated as an ancillary remedy which supports a primary access remedy, whose subject-matter is often physically situated outside the relevant product market that was being analysed. This means that access to ducts and poles is equated much more as a “remedy”, rather than something which relates to a “market” which is susceptible to a competition law analysis. This could change, as practices in market definition for PIA evolve in the context of ex ante regulation. However, such changes could take time, and as previously discussed, the definition of PIA as a separate market, may not be relevant in all cases.

Finally, in the absence of ducts and poles being characterised as a relevant product market in their own right, and in the event that electronic communications operators have not as yet provided access to such physical elements, the market analysis exercise will inevitably shift towards an analysis of whether or not access to such physical elements amounts to an essential facility. This issue has arisen in Member States such as France and Portugal, where access was ultimately granted, but not without a series of appeals to courts. In this regard, it is probably the case that, with respect to new buildings, the costs of individual operators obtaining access to buildings and replicating the relevant infrastructure is unlikely to achieve the status of an essential facility.

For these reasons, we do not consider that alternatives to defining a specific market for PIA are appropriate to address the competitive problem identified during the period of this Recommendation. The case for a separate market will increase, especially once services provided via copper no longer constrain service provision over VHC bandwidth networks. The presumption of the need to define a separate market could however be rebutted in countries where use of utility PIA is widespread and/or alternatives to SMP regulation such as strict implementation of the BB CRD have been applied. In those cases, NRAs would be free to argue that the 3rd criterion is not met.

<u>Conclusions</u>

In cases where PIA is or is likely to be a primary remedy supporting infrastructure competition and new entry in VHC broadband, it is likely to be necessary (at least in the medium term) to define a separate market for physical infrastructure access (ducts and poles). Where it exists, this market meets the three criteria test due to the presence of high upfront costs, limited prospects for replicability and limitations on alternative solutions. It is therefore susceptible to ex ante regulation. In cases where there is no separate PIA market, it may be appropriate to mandate PIA as a remedy in the context of one or more other markets that have been found to be susceptible to ex ante regulation in line with article 72 of the EU Electronic Communications Code.

5.2.4 Considerations concerning geographic segmentation

When defining the boundaries of any market, it is necessary to consider the geographic scope of the market alongside the scope of the product market. In this context, it is important to note that operators investing in their own infrastructure require the means to install their infrastructure with the least inconvenience, greatest relevance (in delivering services to customers) and lowest cost.

In cases where there is a ubiquitous telecom duct and pole network deployed by the incumbent, use of this network is likely to present a considerable advantage for access seekers over use of multiple PIA networks with different standards. Ubiquity and limited transaction costs are likely to be relevant for mass-market operators which are considering deploying their own infrastructure across multiple areas. This is supported by the fact that in countries which have effective access to a ubiquitous incumbent PIA network, this network has mostly been used in preference to other options such as using a combination of SMP PIA and access to utility infrastructure.[293] In view of the relevance of multi-site provision of services for business customers (and to dispersed mobile base stations), the flexibility to roll-out networks to target locations where there is demand and the cost advantages of using a single provider of physical infrastructure, ubiquity is also likely to play an important role for operators deploying infrastructure for major businesses and/or mobile networks.

Indeed, ubiquity plays a significant role in Ofcom's proposal to find a national market for PIA in the context of its 2020 consultation on the fixed telecoms market review.[294] Specifically, Ofcom justifies the finding of a nationwide market on the basis that:

- If fibre is rolled out using an operator's own PIA, it will be limited to local and regional areas
- Even if PIA is built, it is typically for the operators' own use (to deploy VHC networks) and is unlikely to be associated with any interest in providing commercial offers for PIA to third parties, as these would cannibalise its business case for the provision of VHC. As a result, a wholesale market for telecom PIA is unlikely to develop on its own. Therefore, Ofcom has looked at PIA from the demand side

293 For example, despite national rules which require its availability, utility PIA has been less widely used than SMP PIA in countries such as France and Portugal, and where used – is typically tocused on rural areas (pole access). Utility PIA is limited in Spain, potentially due to the presence of widespread SMP PIA which provides a more cost-effective and suitable solution than the use of multiple utility infrastructures.

294 Ofcom (2020).

- Ofcom looks at the needs of PIA seekers and concludes that ubiquitous infrastructure has significant advantages compared to non-ubiquitous infrastructure:
- Ubiquitous infrastructure enables operators to build their networks responding to demand and the location of future demand is not known in advance. It is important for the sustainability of the business case of operators to be able to react flexibly to future demand (independently of whether they target certain customer segments or not)
- Ubiquity allows for more efficient scale and scope of network roll-out
- Combination of multiple non-ubiquitous networks and/or self-built physical infrastructure is costly and operators will try to minimise it
- There may be reasons which compel an access seeker to use different physical infrastructures but this results from necessity and does not constrain the behaviour of the owner of ubiquitous network infrastructure

This argumentation mirrors to some extent the rationale used for the exclusion of utility infrastructure from the relevant market, as use of utility infrastructure may also imply complexity and fragmentation – in addition to concerns, in some cases, regarding its suitability. Ubiquity of the incumbent's physical infrastructure (not only ducts and poles, but also copper) has also traditionally been cited by NRAs as one of the factors supporting the finding of a nationwide market in the context of the WLA market, and is cited in the explanatory memorandum to the 2018 SMP Guidelines as a potential reason not to include more fragmented infrastructures within the relevant market.[295]

Ubiquity also features amongst the characteristics which ARCEP claims make the separate PIA market national in scope.[296] Firstly, ARCEP notes that that the historic incumbent, Orange, possesses and exploits PIA across the whole of the territory. With few exceptions, Orange is the only supplier of PIA for access providers, making the competitive conditions relatively homogeneous throughout the country. Even in areas where civil engineering infrastructure belongs to a third party, Orange remains a major player due to the essential nature of its civil engineering network. ARCEP also observes that demand for PIA is national, and that VHC networks are deployed across all types of territory and operators require access to PIA offers across all territorial areas.

Countries with similar characteristics to the UK and France in terms of a ubiquitous infrastructure owned by the incumbent may find similar conclusions concerning the

295 See page 15 of the staff working paper accompanying the 2018 SMP Guidelines. "The footprint of the networks may play an important role for the question, whether access to the respective network can in fact be viewed as a demand-side substitute. Where the footprint of the respective other network is significantly smaller than the relevant geographic market,47 i.e. not ubiquitous, NRAs may find that even if access to both infrastructures is functionally equivalent, switching would be unlikely because access to the non-ubiquitous network would not allow alternative operators to compete in a sufficiently large part of the geographic market."

296 Paragraph 2.2.2 ARCEP 2020 proposals for PIA market analysis geographic scope of a PIA market. This is even more likely to be the case where operators have already made use of the incumbents' duct and pole network, given the operational and administrative complexity associated with concluding and using PIA agreements, and the lack of potential to switch to alternative arrangements for the housing of installed fibres. Although it is relatively common for access seekers to make use of multiple different wholesale network access offers e.g. for wholesale leased lines in the context of providing services to business users, interviews for this study confirm that, unlike wholesale access to leased lines, dark fibre, or in some circumstances bitstream, PIA is nearly never offered on a voluntary basis by telecom operators. This increases the burden involved in making use of access from multiple providers, since access to every PIA infrastructure may require a complex dispute resolution procedure, and access seekers may face operational obstacles in making use of the service. The volume of disputes raised over access to PIA in the context of the BB CRD in countries where SMP PIA is not mandated, effective and/or widespread also confirms that there is resistance from telecom operators to making PIA available (due to potential cannibalisation), as well as resistance in some cases from utilities which may have other concerns such as liability, safety, cost recovery etc.[297] All these factors would tend to support the notion that a ubiquitous telecom PIA network, where available, is likely to have significant advantages (in both time and cost) compared with a solution involving the use of PIA infrastructures from different parties.

Questions may however be raised about the geographic scope of a potential PIA market in the case where the incumbent's duct and pole access network is not ubiquitous. One scenario in which this may occur is where only part of the incumbent network has been ducted e.g. the segment between the MDF site and street cabinet, but not the final segment, which may remain copper, at least in the short term. Lack of ubiquity may also occur in countries where there are gaps in fixed coverage or where fixed coverage in certain areas has been delivered by an alternative operator rather than the incumbent, whether commercially or in the context of state aid.

In cases where it is not possible for an operator to service the majority of its PIA needs from a single supplier across a widespread area, they would need to self-install or buy a combination of duct and poles from different PIA providers in the telecom sector or from utilities. However, as previously discussed, in this scenario, definition of a separate telecoms PIA market for the purposes of SMP analysis (and the geographic scope of any such market) is likely to be less relevant, and other approaches would be better placed to address challenges in obtaining PIA on fair terms, which may nonetheless remain.

297 European Commission (2018c)

5.2.5 Defining wholesale market(s) for data connectivity

In some cases or areas, NRAs may conclude that duct and pole access alone[298] is sufficient to achieve sustainable competition at the retail level, including the provision of mass-market broadband services, business access and mobile services requiring extensive fibre backhaul. In this case, there is no need to analyse downstream wholesale markets. Indeed, in at least two European countries – Romania and Bulgaria, WLA and high quality markets were found to be competitive and no remedies have been applied, even in the absence of duct and pole access.

However, analysis of data provided by NRAs and the results of their regulatory decisions, suggests that competition problems are likely to persist in many countries, at least in certain areas, even if duct and pole access are mandated and effectively enforced.

Drawing on our review of legal precedents and the approach taken to the ex ante review of WLA WCA and HQA markets, in the following sections, we assess what might the appropriate boundary for a market or markets encompassing wholesale fixed data connectivity. Specifically, we explore the degree to which it may be relevant on an EU-wide basis, to distinguish local from central access, mass-market from business access, and physical from virtual access. We also explore the treatment of cable, mobile and wireless technologies within the relevant market(s), and consider whether there may be merit in pursuing a common approach towards the analysis of backhaul.

5.2.5.1 Should there be segmentation between business and mass-market products at the wholesale level?

As discussed in section 5.1.2, at the retail level, large business end-users are increasingly purchasing complex and bespoke bundles of services which combine connectivity with hardware and applications across multiple locations. Thus, their demands are distinct from those of residential consumers and many small single-site businesses.

However, at the wholesale level, there are some signs of convergence in the nature of the services provided to residential and business customers and potential suppliers of those services.

For example, developments in cable and FTTH PON technologies may enable higher bandwidths, increased levels of symmetric and improved quality characteristics such as latency, which are required for certain business applications (see section 2.6.3). Meanwhile, in a FTTH-based environment, suppliers of mass-market connectivity may increasingly have the capabilities to offer connectivity to the high-end market, making use of their existing networks.

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298 Or dark fibre access in circumstances where competition problems exist, but duct access is not available.

Nonetheless, some distinctions are likely to remain such as the requirements for businesses for short repair times, guaranteed bandwidth, resilience and redundancy, as well as the need for co-ordinated migration (for multi-site businesses).

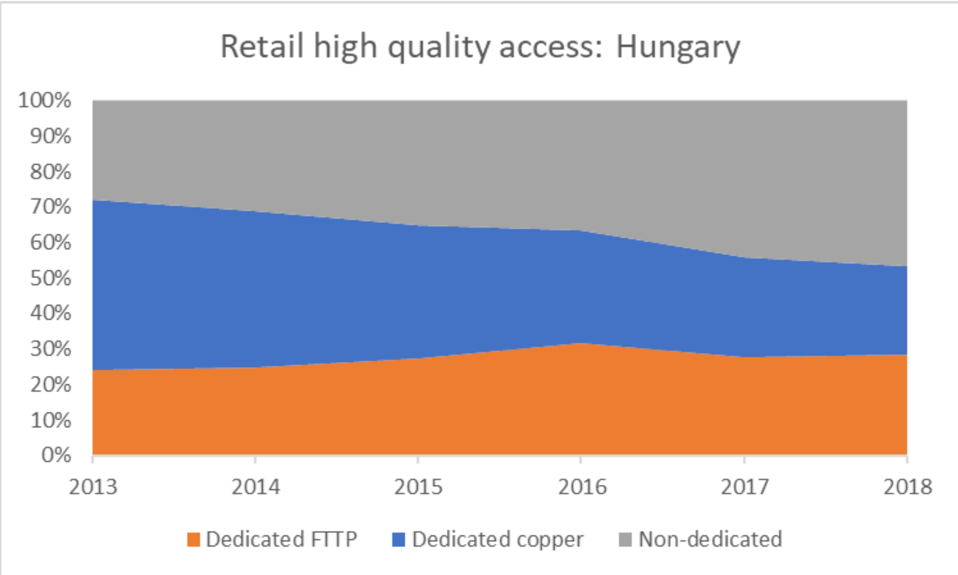
In this context, these may be a case within a wider market encompassing mass-market as well as business-grade wholesale inputs, to consider whether these supplementary services are available on competitive terms, or whether obligations are needed on SMP providers to offer supplementary services which are required for business-grade connectivity.

This approach is already taken in some countries in the context of the WLA market such as the UK and France.

In countries which have not deployed point to point fibre architectures for the mass-market, a further question concerns whether dedicated lines for businesses, which are needed for the most demanding applications and most bandwidth hungry sites, form a separate market segment.

NRAs provided limited data on this market segment. However, for those that did, it is interesting to note that – notwithstanding the growth in business-grade bitstream provided via mass-market technologies – demand for dedicated point to point fibre-based business services is relatively stable or increasing in some cases. For example, data provided by the Hungarian NRA (see chart below), suggests that while the proportion (and absolute number) of dedicated FTTP lines has been increasing, lower bandwidth dedicated copper lines have been in decline, and have potentially been replaced by business-grade services provided via mass-market technologies including FTTC and FWA.

Figure 5-12: Retail high quality access: Hungary



Source: WIK based on data supplied by NMHH

Moreover, certain smart applications and connectivity for big data processing on high performance computers are also likely to require point to point fibre connections, thereby extending the relevance of this option.

Consultation responses

The synopsis report of responses received to the European Commission's consultation on the review of relevant markets susceptible to ex ante regulation[299] notes that the majority of respondents, including BEREC, consider that the market for wholesale high-quality access provided at a fixed location is distinct from the mass-market and should be separately identified in the list of relevant markets. Some of the respondents favouring the continued separation between market 3 and 4 also suggested that its scope should be expanded to include high quality layer-2 bitstream on one end of the quality/flexibility continuum, and/or dark fibre, on the other. However, ETNO and most incumbents generally considered that there was no need to distinguish between markets 3 and 4 because of the potential for VPN solutions to operate over mass-market broadband IP networks, and due to the deployment of VHC infrastructure by alternative operators.[300]

Conclusions

Although in many countries there are clear distinctions today between "mass-market" broadband services and high-quality services offered to businesses, these distinctions may become blurred over time, as technologies permit the channelling of data via secure VPN connections and as FTTH becomes prevalent as a mass-market technology.

With this in mind, mass-market and "business-grade" services based on mass-market infrastructures could, at least in time, be in the same market segment, but may have differing requirements concerning SLAs, which should be reflected by NRAs.

However, the enhanced technological capabilities and the relatively stable demand for dedicated fibre connections, which are required for big data processing and other high end digital applications, suggests that there is likely to be a distinction on the demand-side, which applies at least between connectivity which is provided via shared connections without bandwidth guarantees (i.e. connectivity provided over "mass-market" connections), and dedicated or guaranteed connections.

299 European Commission (2019b).

300 In its submission following the March 2020 stakeholder workshop, ETNO noted that the distinction between shared and dedicated connectivity will blur and therefore ETNO does not agree with including a separate market for dedicated high quality business access in the relevant market recommendation. According to ETNO, M4 does not fulfil the three criteria test as it has become competitive due to VPN based services, more alternative fibre operators and widespread availability of competitive wholesale offerings for connectivity and inputs to business services. Market 4 can be deregulated as it is characterized by technological evolution which makes the high-quality access market manageable through specific remedies in market 3a and 3b.

Noting the analysis of the retail market in section 5.1.2, this distinction is likely to hold on the supply side as well, except in cases where point to point fibre has been deployed to the mass-market, and/or wholesale offers are available on a competitive basis on reasonable terms allowing for competition in the provision of services to multi-site businesses.

However, drawing on experience from countries such as the UK, Ireland and Austria, it is likely that such a product market segment may require geographic segmentation, to address differences in competitive conditions between central urban areas and/or business districts and other regions in which infrastructure-based competition in fibre is less well developed. This market could be considered in conjunction with backhaul (see section 5.2.5.6), as products may be used for both purposes.

Given that there are links and dependencies between the markets for dedicated access and wholesale connections based on mass-market broadband infrastructure (potentially on the supply side, as well as through the use of dedicated (high grade business) links as backhaul to support mass-market fixed and wireless broadband), these markets should be considered by NRAs in tandem. A conjoint analysis of this kind could also allow for NRAs to adjust the boundaries between mass-market (shared) and dedicated access to reflect market developments and any evolution in competition.

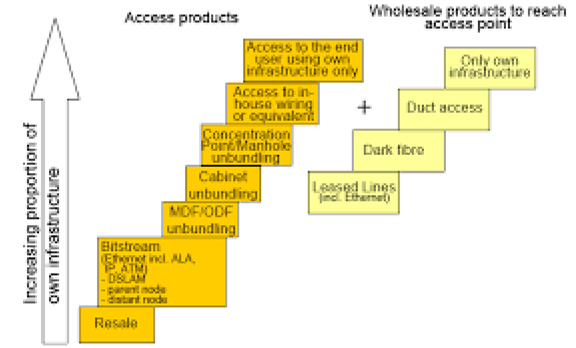
In the following sections we further elaborate on the boundaries within the wholesale markets mass-market data and for dedicated access, and technologies and access points which may be relevant in the context of the Recommendation.

5.2.5.2 What is the scope of the market(s) for mass-market wholesale data access? Should there be a single market for fixed access, or should the market be segmented between passive and active, local and regional?

What is meant by WLA and WCA?

Distinctions between wholesale broadband product markets aimed at the mass-market have typically been founded on the principle of the “ladder of investment”, whereby small scale access seekers may start by procuring wholesale products which allow limited flexibility and differentiation, but also require limited investment in their own infrastructure. Thus, the bottom rung of the ladder of investment may consist in resale products, with steps up for “bitstream” offers available at “regional” connection points, and thereafter local access, which can be made available either via a physical (point to point) connection or (with the migration to NGA) through a “virtual” wholesale access product, which is typically provided via an Ethernet interface and specified in such a way as to allow greater flexibility than a bitstream product.

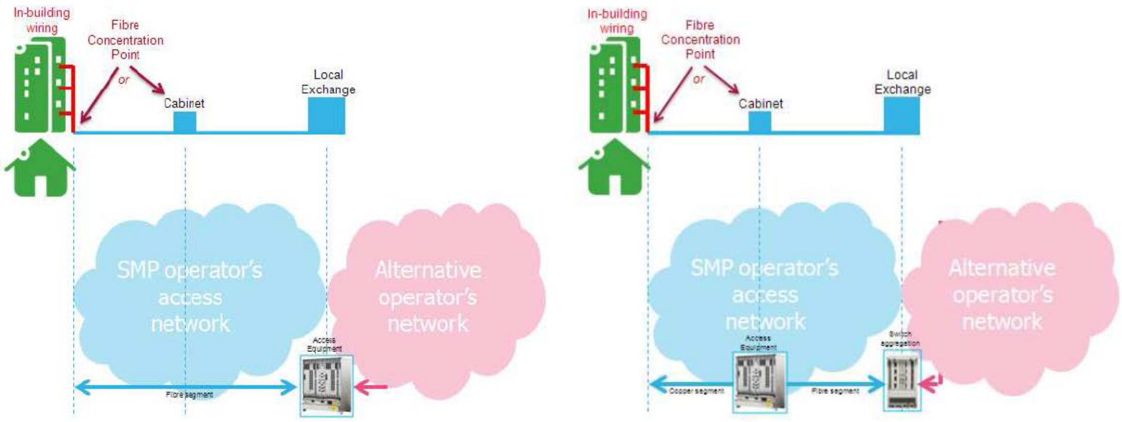
Figure 5-13: Access products along the ladder of investment



Source: BEREC 2009

As shown in the diagram below, in an NGA context with point to multipoint deployment (FTTH PON or FTTC/VDSL), "local access" for the purposes of market definition is considered to include access to the network portion between the end-user and the "local exchange". In an NGA environment, the "local exchange" may be the site where traffic from point to point copper or fibre lines are aggregated (Main Distribution Frame or Optical Distribution Frame), or may, typically for VULA, reflect an aggregation point collecting traffic from a number of (former) copper exchanges. WLA has also been considered to include wholesale products made available at intermediary points between the end user and "local exchange", such as a street cabinet or other aggregation point close to the customer (subloop unbundling). In these cases, backhaul within the "access" network may be available from the subloop to the local exchange level.

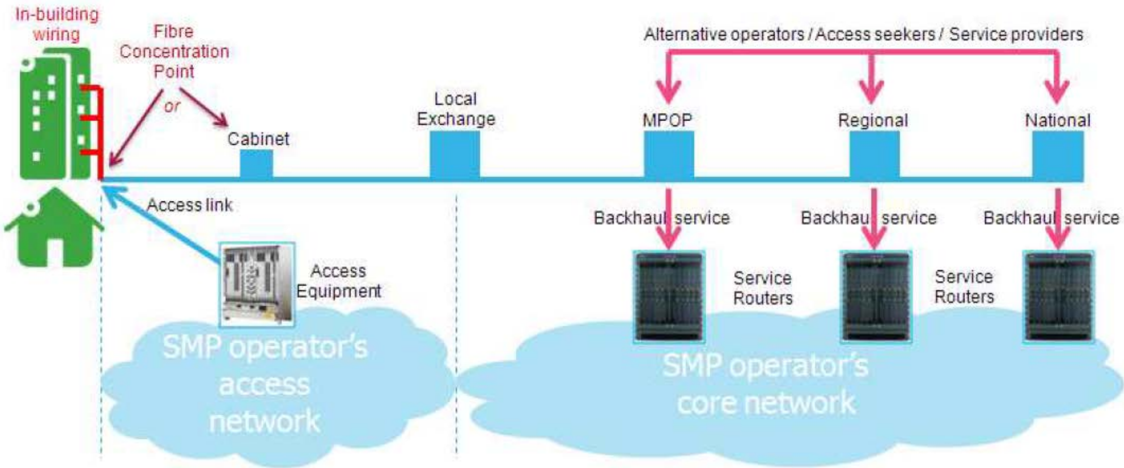
Figure 5-14: Virtual unbundling in the case of FTTH PON or FTTC/VDSL vectoring



Source: Alcatel Lucent 2012

At the next level of the ladder of investment, NRAs have focused on "bitstream" access, which consists of an access link to the customer premises (over copper and/or fibre) bundled with a backhaul services to a defined set of handover points. This is shown in the following diagram.

Figure 5-15: Bitstream access in the case of FTTC/VDSL2 vectoring from the street cabinet



Source: Alcatel Lucent 2012

<u>Approaches taken by NRAs</u>

The current Relevant Market Recommendation advocates a separation that is largely based on the location of the connection point at which traffic is handed over (local vs regional). Regulators have mostly followed this approach to delineating wholesale markets used for the provision of broadband access. However, some variations can be seen.

For example, in France, the Wholesale Local Access market has been treated as a *"passive local access"* market which underpins downstream *active* access markets serving both residential and business customers (see below). ARCEP has now proposed to further segment the passive local access market to separate out PIA (see Figure 5-10).

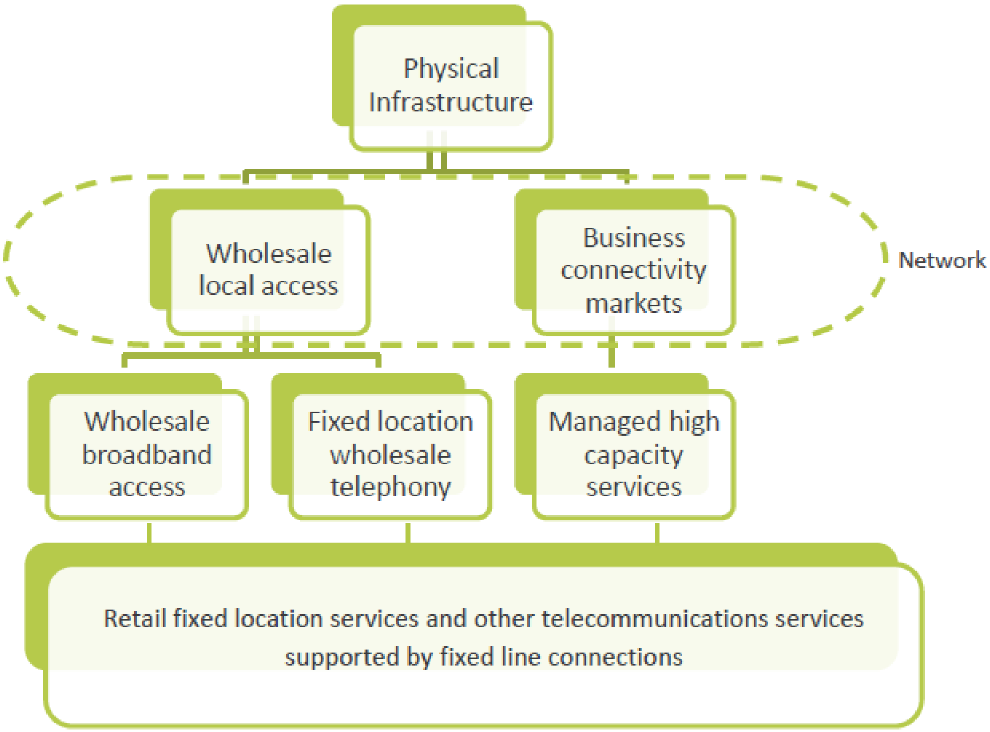
Table 5-7: Structure of fixed access markets in the French market review procedure 2017

<table>
<tr><td colspan="2">WCA market (mass-market bitstream with regional handover, no SMP remedies on fibre)</td><td>HQA market (active, high quality bitstream and leased lines)</td></tr>
<tr><td>Residential segment</td><td>Mass-market business segment</td><td>Specialised business segment</td></tr>
<tr><td colspan="3">WLA market, duct and pole access, dark fibre access and backhaul, copper unbundling</td></tr>
</table>

Source: WIK-Consult

Meanwhile, while the UK NRA Ofcom has split out duct and pole access into a separate upstream “physical infrastructure” market, but the downstream value chain is similar to that defined in the 2014 Recommendation on Relevant Markets, with two “network” markets (for wholesale local access (market 3a) and business connectivity (market 4)), which then feed into downstream wholesale service markets.

Figure 5-16: Value Chain for fixed telecom services



Source: Ofcom (2019).

Conversely, in the most recent market analysis in the Netherlands, the NRA *combined the Wholesale Local Access market with the Wholesale Central Access Market*. On the basis that operators could offer retail services equivalent to those based on (virtually) unbundled access products on the basis of wholesale WBA products over copper and fibre and there has indeed been a switch from unbundled access to WBA, the Netherlands regulator ACM concluded that WBA offered over copper and fibre was a direct substitute for (virtual) unbundled access. Bitstream access via cable networks has also been considered to be in the same relevant market.[301]

301 It should be noted that this Decision was recently annulled by the Dutch Appeals Tribunal (see section 4.2.2), but the focus of the Decision was on the joint SMP finding rather than the market definition per se.

Table 5-8: Products included in the combined market 3a/b defined by ACM

	Markt 3a		Markt 3b
Netwerkniveau	ULL	VULA	WBT
Fysiek ontbundelde toegangsdiensten	SDF-Access MDF-Access ODF-Access		
Virtueel (ontbundelde) toegangsdiensten		VULA	OWM WBT

= Relevante productmarkt

Tabel 3.3 Relevante productmarkt met toevoeging van WBT over koper en glasvezel

Source: ACM

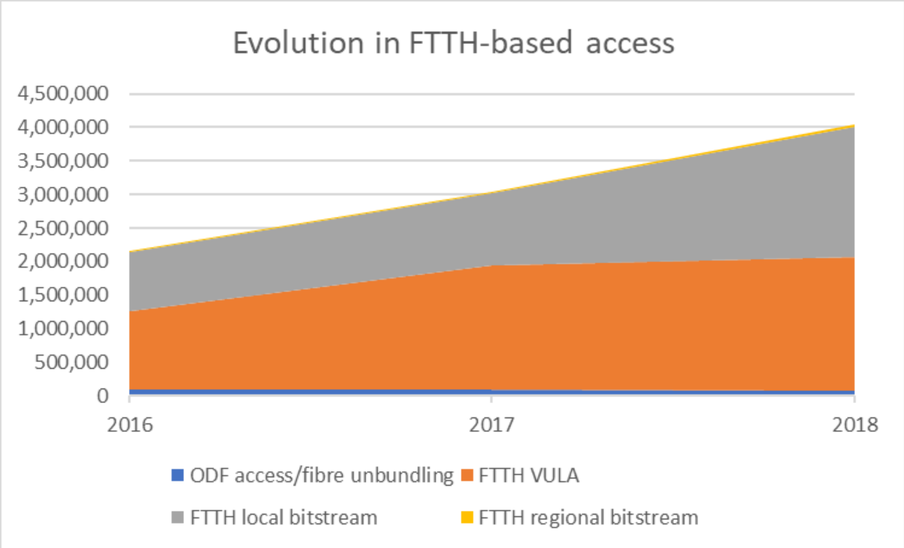
The Danish NRA DBA, has also made proposals to combine markets 3a and 3b in a consultation released in December 2019.[302] They justify the proposal to merge the market segments on the basis that the development of VULA has made local and central access more similar, and note that most lines in Denmark are sold at a central level. It should also be noted that, as in the Netherlands, cable access is relevant in Denmark, and cable is included in the merged market.

As discussed in section 2.7, active wholesale products do not provide the same degree of flexibility for access seekers as passive wholesale products. That is likely to apply, even if flexibility is improved in the context of developments in SDN/NFV, because access seekers would still be limited to the options available to the access provider, and would not be able to innovate in relation to the active equipment.

There is thus an argument to distinguish between passive and active wholesale products, and this may be relevant in countries in which physical unbundling of fibre infrastructure is widely available. However, passive access to NGA networks in the form of fibre unbundling, is not available in many markets and where it is available, it may be geographically limited. Therefore, while desirable, this is not a practical option for many operators today. Indeed, data gathered in the context of this study shows that take-up of unbundled access to fibre is very limited (see following chart), with the exception of France,, in which the NRA required operators to deploy an architecture that would enable such unbundling.

302 Erhvervsstyrelsen (2019).

Figure 5-17: Evolution in FTTH-based access in Europe by access type



Source: Data provided by NRAs October 2019[303]

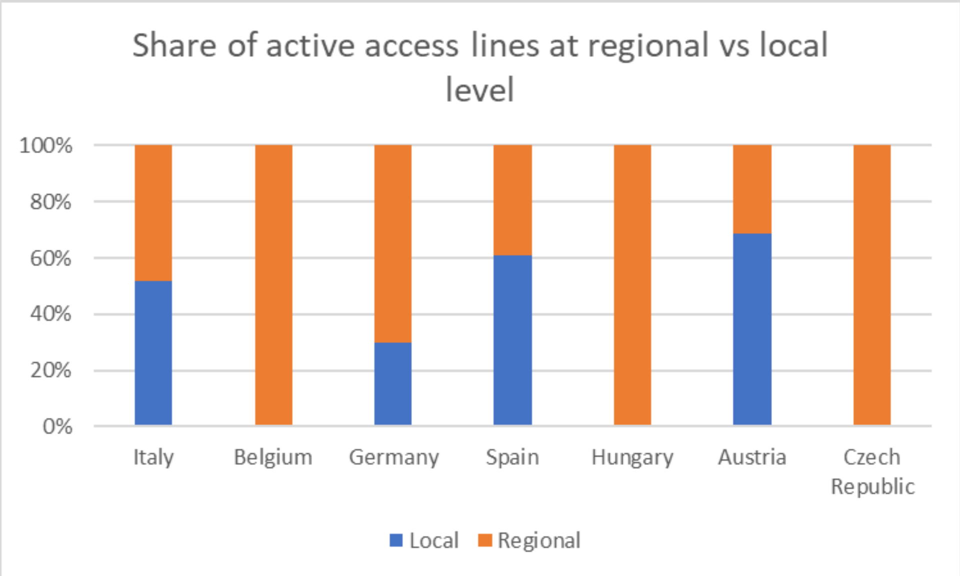
In markets with mixed technologies and without comprehensive availability of fibre unbundling, one option may indeed be to consider, downstream of physical infrastructure access, a market or markets consisting in the provision of wholesale (passive and active) broadband access for the mass-market or business purposes (excluding dedicated capacity).

Arguments that could be made in support of such a solution include the use by single operators of multiple forms of access. Moreover, the capabilities of regional or central wholesale access are likely to increase with evolutions in SDN/NFV, potentially reducing the "flexibility" gap between bitstream and services defined as VULA today. The deployment of SDN/NFV functions, especially combined with network slicing features for the access network are under way and it is realistic to expect that at least some access network providers will have implemented this technology within the next ten years. Wholesale capabilities on cable are also likely to improve, making it more likely in time (and especially following the deployment of DOCSIS 4.0) that cable would be included in any notional market for wholesale physical and virtual unbundled access (see section 2.7). Substitution between local VULA and regional bitstream (even if it does not have VULA characteristics) could occur in response to a price increase for certain types of operators, which have limited backhaul infrastructure and are less concerned with the potential to innovate or differentiate their broadband Internet services, because – for example – they are focused in innovating in

303 Lines are reported as based on local bitstream or VULA based on the classification given by the NRAs providing data. In principle, in line with the 2014 Relevant Market Recommendation, lines described as VULA should meet certain service specification conditions, which allow access to offer similar functionality as physical access. Active lines provided at a local connection point which do not meet these conditions, would be classified as local bitstream a different service or part of the value chain such as mobile or content. Moreover, a shift by access seekers from FTTC/VDSL VULA to more performant cable bitstream products could appear in those markets in which it occurs as a move from “local” to “regional” access.

Another argument to support the definition of a broad market at EU level may be that there are significant differences in the usage of local vs regional active access between different countries in the EU, (as shown in the following chart). This could suggest that it may be difficult to determine on a pan-European level whether local and central access are substitutes or form part of distinct relevant markets. In this context, defining a broad market at EU level, could permit NRAs to segment within that market, tailoring the analysis to their local circumstances.

Figure 5-18: Share of active access lines at regional vs local level 2018



Source: Data provided by NRAs October 2019

However, equally, there are a number of factors which militate against the finding of a single (broad) market for wholesale data access at EU level, combining passive and active, local and regional.

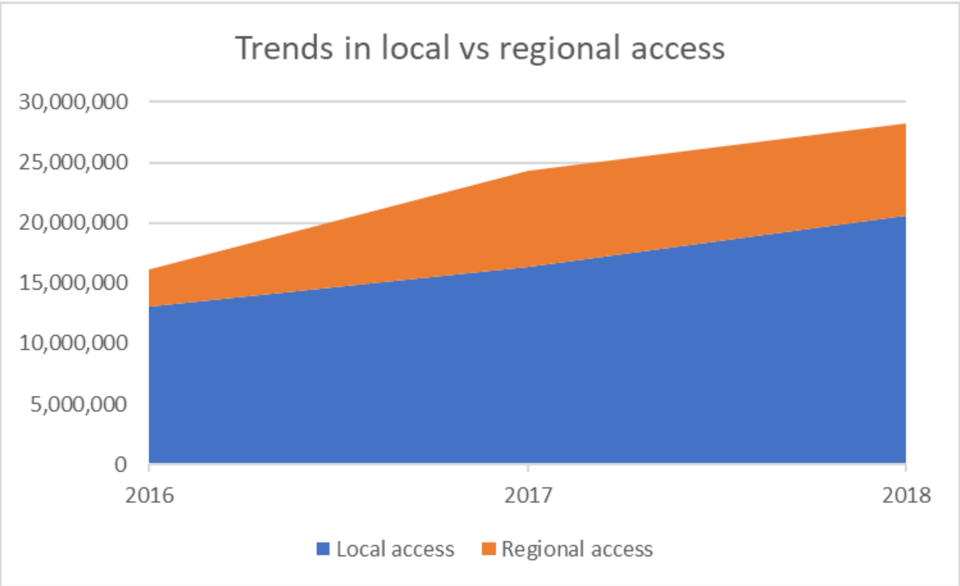
Although future technological developments could increase the flexibility of wholesale offers made available at the regional level e.g. via DOCSIS 4.0 and SDN/NFV, the availability and timing of such offers may fall outside the period of this Recommendation. For example, Liberty Global stated in the context of an interview for this study that they have only recently completed a DOCSIS 3.1 upgrade and DOCSIS 4.0 is not expected within a 5 year period, and may fall towards the end of a 10 year period. Moreover, the development of regional “virtual” wholesale offers offering additional flexibility to existing regional bitstream depends on investments in optional features by access providers, which may not materialize. Providing the same specifications for VULA provided at a regional rather than a local connection would also require dedicated transparent capacity in the intervening network segment (similar to a leased line offered at a central connection), which could significantly increase costs (see section 2.7.2). Failing to do so would on the other hand limit the capabilities of a “regional VULA”, making it less of a substitute for VULA of physical access offered at local level.

Importantly, the choice to make use of local rather than regional access is based on the depth of an operator’s infrastructure. An operator which has invested in its own backhaul network via own infrastructure or IRUs would not find it attractive to switch to regional access even in the event of a small but significant price increase in local access, since that would imply stranded assets and a reduction in control over service levels. Similarly, a smaller operator relying on regional bitstream, may not have sufficient scale to make investments in climbing up the ladder of investment to local access economically viable.[304]

Moreover, regional access may perform a specific function (enabling access to rural and sparsely populated areas or to customers relying on little-used technologies), which cannot be substituted through local access.

This hypothesis may be supported by data provided by NRAs in the context of this study, which shows that usage of “regional” wholesale active access (bitstream) is limited in comparison with “local access” (VULA or bitstream) (see chart below), but is nonetheless relatively stable (see below).

Figure 5-19: Trends in local vs regional wholesale access



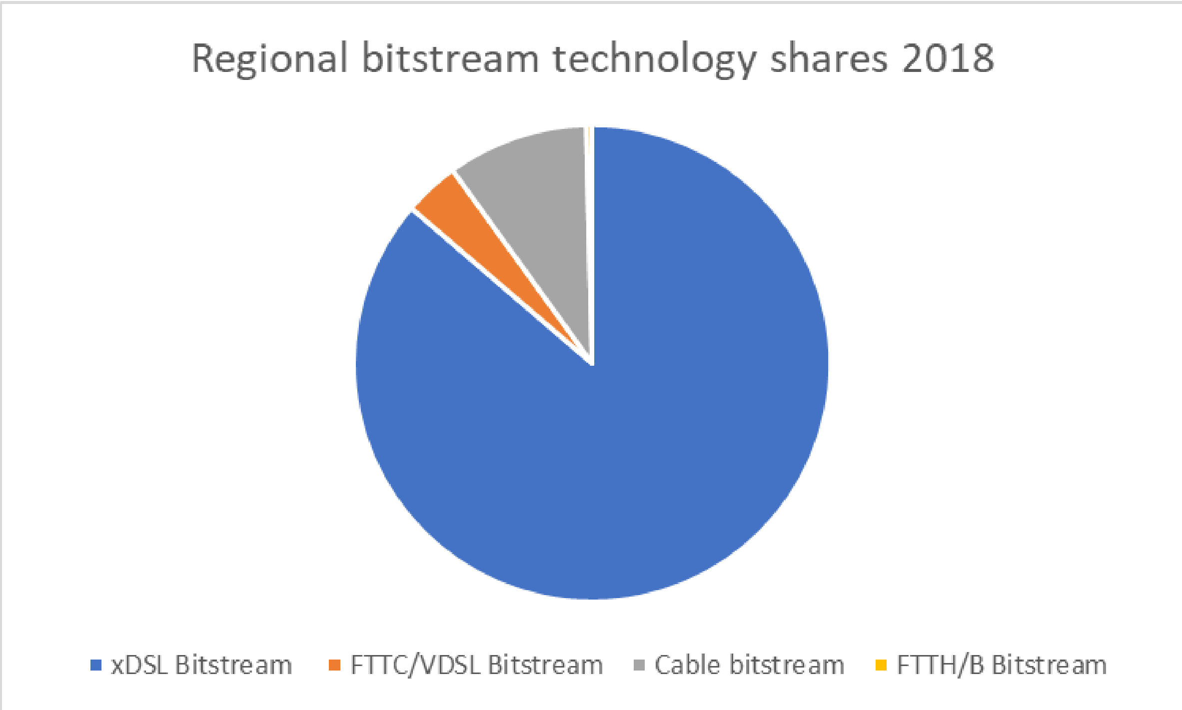
Source: Data provided by NRAs October 2019

304 Some of this behavoir has been modelled in a cost and market model WIK-Consult provided to the Dutch NRA ACM. It models the situation of wholsale access seekers of different sizes and the wholesale services they may start with – along the ladder of investment: small entrants with central bitstream, migrating to regional bitstream, to regional VULA, to Fibre and copper LLU/SLU. The steps depend on the market size (penetration) of the access seekers in the different regions and depend on the additional cost to climb up to the next step. See Kroon et al. (2017).

Continued usage could reflect the fact that access seekers may rely on regional bitstream access in certain areas such as rural areas, on a longer-term basis, because it not economically viable to build or buy backhaul infrastructure to reach those areas due to low population densities, or to reach customers that are resistant to migrating to modern technologies.

This hypothesis is supported by the fact that NRAs reported that the vast majority of regional bitstream lines are based on copper-based xDSL, which tends to be more prevalent in rural areas.

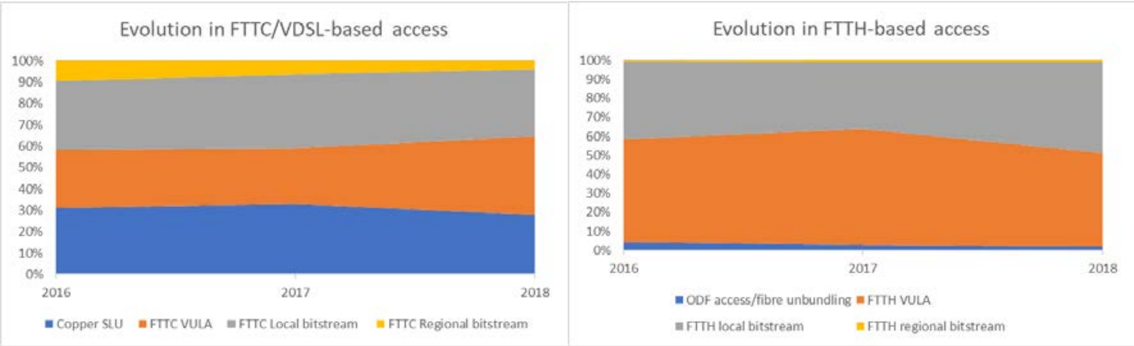
Figure 5-20: Regional bitstream shared by technology 2018



Source: Data provided by NRAs October 2019

In contrast, the majority of FTTC- and FTTH-based access lines were based on local active access (VULA or local bitstream), as shown in the charts below. This may suggest that regional bitstream is a product that could decline with the migration from copper to VHC technologies. However, the number of regional bitstream lines for FTTC and FTTH are expanding in absolute terms, and it is possible that regional bitstream on FTTC and FTTH may become more prevalent as these technologies are installed in rural areas.

Figure 5-21: Evolution in demand for FTTC/VDSL-based access and FTTH-based access



Source: Data provided by NRAs October 2019

Relative demand for local vs regional access, and the implications of a small but significant price increase in regional access on demand for local access, could also be influenced by the availability and terms for backhaul access. This is based on a presumption that if products were made available in a more “unbundled” manner, separating the local access element from backhaul, there could be less need to rely on regional bitstream, and a cleaner split could be identified between the wholesale product markets, distinguishing wholesale local access from backhaul and a downstream market for regional or central access, combining both elements with additional active equipment. In this context, it is possible that the limited demand for bitstream in France and the UK amongst the larger Internet providers may be due in part to the availability of regulated inter-exchange connectivity coupled with local access, while it is possible that the absence of such regulated access to backhaul may support higher proportions of bitstream in other countries, although this is not the only factor.[305]

It is also notable that in France, the NRA has given significant focus to fostering competition in bitstream and wholesale leased line services for businesses on the basis of regulated upstream local access inputs (PIA and fibre unbundling in the French case). This would tend to further support the case that there are separate wholesale markets for WLA and WCA, with the potential to achieve a greater degree of competition in the WCA market, based on wholesale supply from infrastructure owners as well as those purchasing regulated inputs upstream. The distinction is particularly clear in France as local inputs are based on passive access (physical unbundling). In theory, access seekers could also make use of VULA to offer downstream bitstream offers with a regional or national aggregation point.

305 In countries where alternative operators offer broadband as an add-on to other services such as mobile or content, they may opt for broadband wholesale products which involve less investment such as central access. Alternative operators may also be more likely to use central access in the first phase of entry, prior to “climbing the ladder of investment”. Use of wholesale access types that are inherently offered at regional level such as cable, may also affect usage

Input from the consultation and workshops

Alternative operators responding to the Commission's consultation, including those represented by ECTA, argued that the revised Recommendation should maintain a clear differentiation between local and central access, as operators with different business models require different types of access.[306] The cable operator Liberty Global and alternative investors in fibre infrastructure for consumers and business customers such as Open Fiber, BREKO and COLT also considered that markets 3a and b were distinct.[307]

This view was shared by several of the NRAs participating in the BEREC workshop on the Relevant Market Recommendation. They highlighted that local and regional access were distinguished not only by the location of the connection point, but also by the capabilities of access, whereby local access should offer flexibility which is as far as possible equivalent to that provided through physical unbundling. Moreover, these markets were considered to lie at different levels of the value chain, and some NRAs expressed concern that combining them could lead to increased regulation, and undermine the trend towards geographic segmentation and deregulation, that has occurred in regional bitstream in many EU member states. In other words, such an approach could jeopardise incentives to climb the ladder of investment and deregulate wherever justified. However, other NRAs participating at the BEREC workshop, considered that defining a single market encompassing both local and regional access, would make little difference to their analysis.

On the other hand, ETNO and incumbents responding to the Commission's consultation mostly argued in favour of a single "wholesale fixed network access" market in which WLA and WCA are combined. They cited indications of substitution between physical/passive and virtual/access products, and pointed to the replacement of copper unbundling and layer 3 bitstream with virtual access products offered with local, central or regional handover.

Conclusions

NRAs in different countries have pursued a variety of approaches in identifying the scope of wholesale broadband access markets. While some maintain a distinction between

306 These views were further confirmed and elaborated in the context of reactions to the public workshop held on 6 March 2020 in the context of this study. ECTA noted that from a technical and product design perspective, no access seeker would voluntarily migrate to a central access product and take into account the deterioration in product quality and control compared to a local access product.

307 Open Fiber noted that market 3a and 3b were clearly separate. According to Open Fiber, OLO's capability to respond to a price increase is limited due to the high cost of entry in local access. Eurofiber shares a similar view, considering a voluntarily migration an unlikely scenario as a price increase for local access would logically also lead to a price increase at the regional/national access level, for which local access is an input. Colt notes that no alternative operator would voluntarily climb back down the ladder of investment. BREKO believes that the current separation of wholesale local and central access should be maintained, as it has proven to be effective in many Member States. If at all necessary, BREKO is of opinion that national authorities should be given the opportunity to implement changes. Liberty Global is also strongly opposed to any combination of the current markets 3a and 3b as they are not substitutable from the perspective of an access seeker. Moreover LG notes that a combination would go against the ladder of investment principles, reducing attractiveness for access seekers to invest in their own infrastructure.

regional/central and local (including physical or virtual) connectivity, others such as France have maintained a passive/active distinction, and some, including the Netherlands and Denmark, have opted or proposed to define a single market encompassing both.

In cases where physical fibre unbundling is available on a point to point infrastructure, there may be a case to define a specific market for physical unbundled infrastructure access, as this type of access objectively offers significantly greater flexibility than active access, and can be used for more purposes, including high-end business use.

In countries where the architectures make it difficult to provide unbundled access at an economically viable access point, current evidence supports the maintenance of a distinction between local (physical or virtual) access and regional/central access, with the WLA market lying upstream of the WCA market. Upcoming technological developments may increase the flexibility of access that is possible at the regional level, but their provision requires investments by the wholesale provider, the availability and timeframe for provision of these wholesale products is unclear and the availability of more flexible regional wholesale access products will not necessarily encourage access seekers to switch from one to the other, especially if they have made investments in backhaul. A clear focus on a local (physical or virtual) wholesale access market, in which there are clear criteria concerning the flexibility that must be made possible via wholesale access would also support efforts to ensure that new technologies including SDN/NFV and technologies allowing wavelength unbundling, are installed in a way that permits the provision of access which allows flexibility for the access seekers and enables them to maximise the use of their own or competitively provided backhaul.

Greater focus on backhaul e.g. in the context of a market for dedicated terminating segment connectivity and/or inter-exchange connectivity could help to maximise the degree of competition that is possible at each level of the value chain.

If this solution (to maintain separate markets) is pursued, there would remain the option for NRAs to adjust the boundaries of the market or combine wholesale products in markets 3a or b, if justified on the basis of national circumstances coupled with an assessment of the 3 criteria test.

Another option could be to define a single market at EU level which encompasses local and regional/central access (e.g. a market for fixed wholesale data connectivity), in recognition that there may be different circumstances applying in different countries. However, this would provide limited guidance on the appropriate approach to take at national level, and it is likely that NRAs would in many cases need to further segment the “wide” market to reflect distinctions in the demand and supply conditions for passive vs active or local vs regional wholesale products.

5.2.5.3 Should cable be included in the market or markets for wholesale mass-market data connectivity?

NRAs have taken varying approaches towards the inclusion or exclusion of cable in the WLA and WCA markets, and in some cases this decision has proven to be an important factor in determining whether joint SMP should be considered.

The potential for cable to substitute for other broadband access technologies depends on

a. the degree to which it offers a functional substitute for customers – noting that the needs of residential and business customers may vary;

b. the capability of cable to offer equivalent wholesale capabilities – including flexibility – to wholesale offers made available via FTTx technologies;

c. the degree to which there might be new entry based on cable platforms or operators could and would be able to switch to cable wholesale products in the event of a price increase on FTTx.

Meanwhile, in cases where there is no supply and limited demand for cable access, the question remains whether cable applies an indirect constraint on the conduct of the incumbent in the WLA and/or WCA markets.

Overview of findings by NRAs

Table 3 gives an overview of the analysis conducted by NRAs, which have included cable in the relevant markets (3a and/or 3b). Belgium, the Netherlands and Denmark have included cable in market 3b, but not in 3a, while the UK regulator has included cable in both the WLA and WCA markets on the basis of indirect constraints.

Table 5-9: Overview of the analyses conducted by specific NRA to include cable in the relevant markets.

	Cable as part of market 3a		Cable as part of market 3b	
	Direct constraints	**Indirect constraints**	**Direct constraints**	**Indirect constraints**
NL	No local cable access product available. ACM considers cable access to be a bitstream layer-3 product	n/a	Testing of functionality, prices and switching potential. Conclusion: substitute for new entrants, not for existing market players.	Yes (based on SSNIP analysis)
BE	No (neither for VULA cable, nor physical unbundling cable or frequency unbundling) Main reason: high switching costs	No indirect constraints from cable on the wholesale local access market (reference made to market 3b)	BIPT defines a separate wholesale access market for cable products, as standardisation is different, which inhibits switching between copper/fibre and cable	No, based on a critical loss analysis there are no indirect constraints from cable
DK	No (technically and commercially not a substitute (neither physical nor as VULA)	n/a	Cable is covered by the relevant product market of 3b (mass-market) Yet, no remedies imposed, as DBA considers this not proportionate in the view that there are existing commercial offers in place	n/a
UK	No, because there are no cable-based wholesale local access products	Yes, based on an SSNIP-Test a HM is unable to raise prices profitably	No, because there are no wholesale cable services	Yes, reference made to market 3a decision

Cable as functional substitute for consumers

Our technological analysis suggests that DOCSIS 3.1 cable offers similar functionality to point to multi-point FTTH broadband connections and that it may be able to keep pace with developments in P2MP fibre based on future upgrades to DOCSIS 4.0, although such upgrades are likely to take time (see 2.6.2).

From a commercial perspective, several of the NRAs (e.g. NL, BE, DK, UK), which have included cable networks as part of the relevant retail and wholesale markets associated with broadband connectivity, have concluded that cable networks offer the same retail services as copper and fibre networks. ACM also notes that retail prices for services over copper and cable networks are similar. This implies, in the opinion of the ACM, that wholesale services over copper and cable networks should also be comparable in terms of price and functionality, since these providers allow the provision of retail services that are interchangeable from the end-user's perspective. Moreover, the fact that the vast majority of cable customers can also be served via FTTx or xDSL connections, means that – from a wholesale perspective, operators could in theory make use of cable connections to reach the same clients as those served by the incumbent in the cable coverage area. Ofcom also cites as evidence[308], the fact that price comparison website provide details of cable alongside copper/fibre services, existing switching between different networks in cable areas and evidence of “upward pricing pressures” i.e. indications that the incumbent could, in the absence of competition from a cable operator, have the scope to charge higher prices.

However, NRAs have in many cases found that the principle of equivalent coverage and functionality may not always apply to businesses. In particular, SMEs and large businesses, as well as those located on business parks, may not be served with a cable connection. Moreover, the SLAs and capabilities offered via cable may fall short of those expected for high-end business applications. These differences may, decrease with next generation cable upgrades and the deployment of fibre further towards the end-user in the context of cable networks. However, cable networks would still not be capable of meeting the needs of high-end business customers, which require dedicated capacity (see section 2.6.2).

Equivalent wholesale capacities between cable and copper/fibre

When it comes to wholesale capabilities, more differences arise between the two technologies – especially when considering wholesale access provided at the local level.

1. Wholesale local access

In the case of wholesale access at local level (whether physical or virtual), it should be noted that coaxial cable, i.e. the most local part of the cable operators' network, is a network component shared between different users, as opposed to the copper local loop in the

308 Ofcom (2018, para. 3.57 ff.).

incumbents network (where each user has a separate local area network). Full physical access would therefore require physical access (and set up of transmission equipment) to take place outside the premises of the individual retail customer. In practice, this will be equivalent to building a parallel access network and is therefore not considered commercially feasible. As a result, the Dutch, Belgian and Danish argue that physical unbundling of the cable at a level similar to that of the copper local loop (local exchange or street distributor) has not been conceivable in the past and will not be conceivable in the foreseeable future.

With regard to the potential for cable to offer VULA-like access, one of the concerns highlighted by several NRAs is that the shared architecture of DOCSIS 3.0 and 3.1 and lack of sufficient capacity would make it challenging to provide linear IP television to all consumers, while DVB-C channels cannot readily enable exclusive transmissions. Some of these constraints may be addressed in the medium term in subsequent upgrades of cable networks, e.g. through full duplex cable networks (as part of DOCSIS 3.1.).

Moreover, shorter term solutions concerning TV delivery have been found in some cases, notably via a commercial cable-bitstream offer from TDC which enables alternative operators to offer TV packages to retail customers via IP-unicast, which the companies themselves composed.

However, notwithstanding this solution, DBA notes, that current cable bitstream access does not meet the criteria required for WLA, because capacity is shared dynamically between the companies using a given network, the connection is largely contended in the access part of the network. The wholesale customer does not have the opportunity to monitor, correct or change the connections (control over the connection). The wholesale customer also has restrictions on what services can be provided (service independence). The collection will in principle be possible locally, but in isolation would not give the wholesale customer any advantage over a more central collection, as the other criteria will not be met. Therefore, it is not economically viable for the wholesale customer to make investments in infrastructure in order to take over the data traffic locally.

ACM notes with regard to access to the cable network in the Netherlands that the so called CMTS location (local access point) is not a suitable choice for this, because the CMTS is not a future-proof location and because it is unlikely that there will be a positive business case for this. In view of ACM and DBA interconnection should therefore take place at a higher network level, i.e. at Regional or National Head Ends.

Overall, local access is theoretically possible, but it does not offer the wholesale seeker an advantage over regional access and is therefore considered to be commercially unviable.

2. Wholesale central access

For the reasons described above, NRAs have generally considered cable access to be more relevant for the WCA market (market 3b), or in the case of ACM – to a market which combines WLA and WCA.

For example, the DBA concludes that virtual connections in cable networks fulfil the core characteristics that characterize the products that belong to the wholesale market for central network access. Therefore, the cable TV platform is covered by the relevant product market 3b.

Similarly, ACM noted that the DOCSIS-standard should allow provision of a layer-3 access service (bitstream). In this context WIK found in a study conducted for the ACM[309] that the outcome of the business case for an entrant that offers retail services to end-users via a layer-3 access service on the cable network would be positive.

Central access on the cable TV platform means that traffic is collected by the wholesale customer at the regional or national level. In cable TV networks, there will be collection at the CMTS or a location that is more centrally located in the network.

In cable TV networks, the wholesale customer can offer broadband to retail customers from a few centrally located points in the network. Thus, the criterion of the possibility of central network access to collect traffic is met (central network access).

However, it should be noted that cable architectures – at least as currently formed – have significant limitations in terms of control over utilization and the potential for guaranteed bandwidth, such as may be required by some corporate customers. This is because the cable TV network is built in a tree structure where all connections connected to the same "island" share the available capacity.

Based on cable capabilities in the short and medium term therefore, centralized retail customer services are typically solely used to provide generic broadband services to the mass market.

The use of cable bitstream as an alternative to xDSL or FTTx bitstream has been increasing in markets where such access has been mandated by the NRA or where (e.g. in France) the cable operator has voluntarily provided cable bitstream.[310] Meanwhile, TDC has played a more active role in the provision of cable-based bitstream access since launching a commercial offer (in use since April 2016) for alternative telecommunications companies to access its cable TV network.

NRAs responding to a data request in the context of this study reported a total of 590,000 cable bitstream lines in 2013, increasing to 1.6m such lines in 2018.

309 Kroon et al. (2017).

310 French cable operator Numericable initially provided cable access on a commercial basis to operators such as Bouygues Telecom. Following the merger between Numericable and SFR, the French competition authorities mandated the supply of cable bitstream by the merged company. The Commitments originally made in 2014, were however not renewed at the time of the Competition authority's review in 2019 (LesEchos 2019).

Degree to which there might be new entry based on cable platforms or operators could and would be able to switch to cable wholesale products

Although cable and xDSL/FTTx bitstream products may be functionally substitutable to a large extent, the degree to which the prices of one can be constrained by the prices of the other also depends on the degree to which operators entering the market could choose between these two options or existing operators could switch from one platform to the other.

ACM handled this question in the following manner.

> New entrants: If prices and functionality are comparable at both retail and wholesale levels, in the event that we increase wholesale prices for access to the copper and fibre networks by 5 to 10 per cent, a new entrant will, in the opinion of the ACM, opt more quickly for access over the cable network. This may prevent an increase in the wholesale price for these customers from being profitable for the supplier.
>
> Existing customers of access to copper or fibre networks: These customers have already invested to obtain access to copper and fibre networks. These investments are relatively low for parties that use the incumbents wholesale broadband access offering and therefore interconnect on a national level. These parties can relatively easily switch with their entire customer base but may incur switching costs.

On the basis of a critical loss analysis[311], ACM noted that even if a relatively small proportion of wholesale access customers (to the copper or fibre network) were to switch to VodafoneZiggo cable network in response to a price increase, this could already have a disciplining effect. This is also the case if one or more wholesale customers migrate some of their customers. In the latter case, it is not unusual for the customer to use two different infrastructures to serve different customer groups.

As there was no wholesale offer for access to VodafoneZiggo's cable network, there was at the time of the analysis no effective switching of wholesale customers from copper and fibre networks to cable networks. However, several market players had expressed an interest in obtaining access to VodafoneZiggo's cable network. ACM concluded that there was therefore a potential demand for access to cable networks, and that switching might occur if the product was available.

BIPT examined the same issues, but reached a different conclusion concerning the relevance of new entry and potential barriers to switching between the platforms. BIPT noted that, both in the case of a cable-based (local) VULA access as well as in the case of cable-based bitstream access, alternative operators wishing to replace the unbundling local loop of the incumbent would face high switching costs, besides the long period it would take to switch. Reasons for high switching costs included:

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311 ACM (2018), Wholesale Fixed Access Market Review https://www.acm.nl/sites/default/files/documents/marktanalyse-wholesale-fixed-access-20180928.pdf

- the need to change the equipment (CPE) of its customers;
- to invest in CMTS-type equipment rather than in DSLAMs;
- the need to have qualified staff to work on this equipment (either recruitment or training);
- the need to extend its infrastructure to the head-ends of the cable operators (because they are not located at the same location as the main distributors at the level from which it is possible to gain access to the copper local loop).

Based primarily on the perceived high switching costs, BIPT concluded that there were separate relevant markets for bitstream provided under the SG15 standardization and the CableLabs standardization[312], and identified two distinct WCA markets. This view was challenged by the European Commission in its comments letter on the case. However, the Commission noted that BIPT had demonstrated that it would have reached the same conclusion regarding the finding of SMP on cable operators and justification for imposing remedies, had they included cable in the relevant market and concluded an analysis of joint SMP.

<u>Relevance of self-supply and indirect constraints</u>

Most NRAs have excluded cable from the WLA market on the basis that it does not provide a direct constraint to physical unbundling and VULA services.

Ofcom, concurred that there are no direct constraints between cable and copper/fibre networks at the wholesale level because cable operators (as well as other alternative networks) do not offer a local wholesale product. However, in its previous analysis of the wholesale local access market[313] Ofcom concluded that cable should be considered to be in the relevant market on the basis of indirect constraints.

Ofcom notes, that when considering the impact of indirect constraints on wholesale charges it is necessary to consider dilution and pass-through. "*Pass-through refers to the extent to which an increase in the wholesale price of one input is passed through to retail users in the form of higher prices. Dilution refers to the fact that there may be other costs associated in the provision of retail services, and so a 10% increase in the wholesale price of one input may represent a less than 10% increase in the retail price even if there is full pass-through.*"[314] Ofcom considers that it is reasonable to assume approximately full pass-through of the absolute amount of a wholesale SSNIP in the retail price for the purposes of the

312 The fixed broadband access services covered by the CableLabs standardisation are the HFC networks (including the FTTLA - Fiber To The Last Amplifier) and HPON.
313 Ofcom (2018, para. 3.60 ff).
314 Ofcom (2018, para. 3.64).

SSNIP test. For the dilution ratio Ofcom considers 50% to be reasonable broadly reflecting current relative wholesale and retail charges.[315]

Ofcom states that at the retail-level, services provided over each network (copper/fibre and cable) are likely to be close substitutes. Therefore, Ofcom analyses the retail offers of BT and Virgin Media (the largest of two cable operators in the UK) and concludes that their offers have several similar characteristics and are targeted at similar customers and at comparable prices. Ofcom notes that BT's tariffs are available nationally and there has been no evidence found that BT discounts from list prices more heavily in cable than in non-cable areas.[316]

Based on a SSNIP test[317] Ofcom states that a hypothetical monopolist of copper/fibre connections, either vertically integrated or wholesale-only, is unlikely to be able to profitably impose a SSNIP above the competitive level due to substitution to retail packages over cable. Ofcom therefore concludes that cable is a sufficiently close substitute to retail services over copper/fibre connections such that cable access can be regarded as part of the same market as access over copper/fibre.

Consultation responses

The inclusion of cable in the market was not discussed at length by respondents to the Commission's consultation. The cable operator, Liberty Global's response, suggests that they favour a continued distinction between WLA and WCA and do not consider that cable technology can provide a substitute for WLA. KPN, the incumbent in the Netherlands considers that the WLA and WCA markets should be combined given migration from passive access towards VULA and active access, and concluded that cable should be included in this market.

Conclusions

Cable technology is available in a significant number of member states. Where it is present and relatively widespread, as can be seen in the Dutch and Belgian cases, the inclusion or exclusion of cable in the relevant market(s) for wholesale data access may have important implications for finding or otherwise of individual or joint SMP.

In the majority of cases, NRAs have concluded (mainly for technological reasons) that cable cannot today substitute for physical or virtual unbundled access. However, Ofcom has concluded that cable can be considered to be in the WLA market based on indirect constraints.

In contrast to WLA, where it has typically been excluded, most NRAs have included cable within the WCA market (or merged markets combining WLA and WCA), and there is

315 Ofcom (2018, para. 3.77).
316 Ofcom (2018, para. 3.73).
317 Ofcom (2018, Annex 5).

evidence from several countries (including Denmark, France, and Belgium) that where regulated or commercial cable is available, some alternative operators have chosen to use it as an alternative to other forms of wholesale broadband access.

The prospects for cable-based access to enable service differentiation meeting VULA standards are likely to increase with the deployment of DOCSIS 4.0. However, cable operators such as Liberty Global have signalled that such deployments are many years away and are unlikely to be relevant during the current review cycle. This means that cable bitstream is unlikely to become a direct substitute for FTTx VULA or physical unbundling. That said, cable could be included in this market on the basis of indirect constraints in the event that a price increase on WLA could trigger retail customers to switch from the FTTx platform onto cable. This may be relevant in countries or regions where cable is widespread and there are few barriers to switching between platforms at the retail level.

Cable should generally be included in the WCA market. Whether the WCA market includes all broadband technologies capable of providing bitstream offers or consists of separate segments e.g. for FTTx and cable depends on the degree of constraints on switching at the wholesale level. In this context, it should be noted that switching between cable and copper/fibre platforms may give rise to costs and potentially stranded assets for access seekers. If these factors are significant such that one platform could raise prices above the competitive level without risk of losing wholesale market share, then separate segments should be identified for each technology group.

However, new entrants to the market would not be affected by any such switching costs and therefore, a degree of pricing constraint might apply in the event that new entry could be reasonably expected. Furthermore, as discussed in the explanatory memorandum accompanying the SMP Guidelines,[318] the introduction of standardized interfaces could be expected to evolve in a market in which cable companies voluntarily provided access and sought to encourage wholesale companies to switch. This would support a conclusion that the technologies should be considered to be in the same relevant wholesale market as copper and fibre from a greenfield perspective, but should be weighed against the factual situation facing operators in the market.

5.2.5.4 Should copper be included in the relevant market for wholesale data access?

As discussed in section 5.1.4, most NRAs have concluded that there is a chain of substitution covering all broadband technologies ranging from copper through to the most performant point to point fibre technologies.

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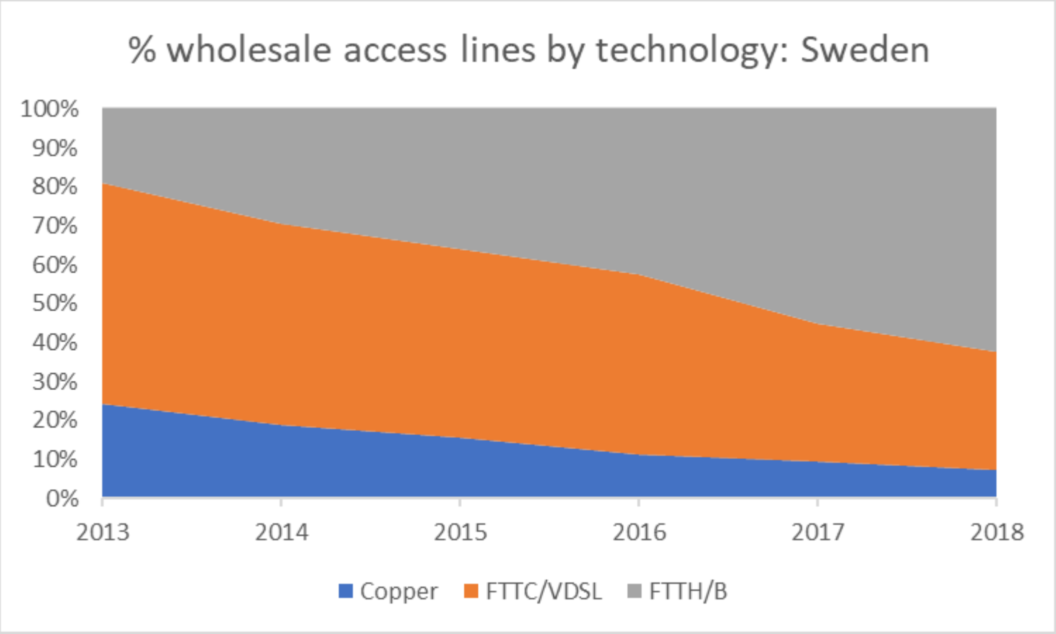
318 European Commission (2018b). Guidelines on market analysis and the assessment of significant market power under the EU regulatory framework for electronic communications networks and services, page 15 “inter-platform markets”

However, as new services evolve which require low latencies and high (and potentially symmetric) bandwidths, and as the technological capabilities extend the gap between the performance available via next generation cable and fibre technologies – and copper (see section 2.6.3), there is a case that the chain of substitution between lower and higher bandwidths or copper-based access and access based on technologies offering more advanced capabilities could be broken.

In line with its conclusions at the retail level, the Swedish regulator has proposed to distinguish markets for copper-based wholesale products from those for VHC wholesale products.[319] This conclusion is consistent with the declining relevance of copper at retail level in Sweden, alongside the decreasing reliance on copper wholesale access including LLU and ADSL bitstream in Sweden (see following chart).

Figure 5-22: % wholesale access lines by technology: Sweden



Source: WIK based on data provided by PTS

In a December 2019 consultation, the Danish authority DBA, also proposed to segment copper from VHC networks within a combined wholesale fixed access market.[320]

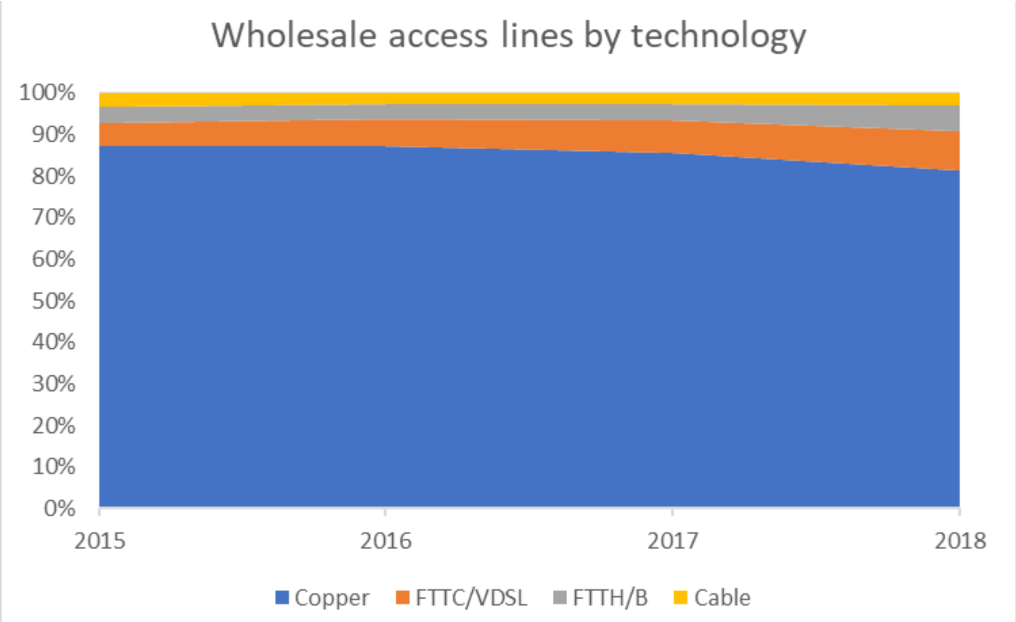
The planned decommissioning of all MDFs in Norway by the end of 2022[321] is also likely to require a recalibration of the scope of the market.

319 PTS (2019b).
320 Erhvervsstyrelsen (2019).
321 See BEREC (2019a).

The reduction in reliance on wholesale copper access, and move towards self-supplied fibre access or fibre wholesale access is also apparent in countries such as Spain and Portugal, in which the transition to FTTH is well under way.

However, at the moment, wholesale access in most other EU countries for which access is relevant, remains predominantly reliant on copper-based LLU (see following chart) or the hybrid FTTC/VDSL network of the incumbent.

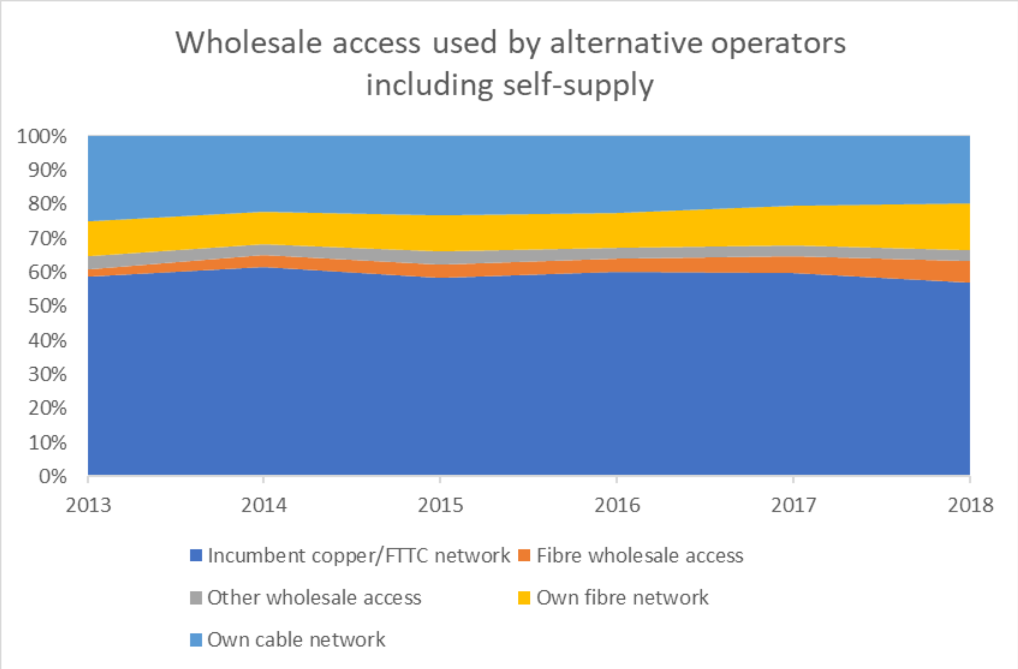
Figure 5-23: Wholesale access lines by technology: EU



Source: WIK based on NRA data

The reliance in many countries by alternative operators on copper access products from the incumbent is still apparent, when we also take into account self-supply of wholesale access by alternative operators i.e. the use of their own fibre or cable infrastructure (see figure below).

Figure 5-24: Wholesale access used by alternative operators including self-supply



Source: WIK based on NRA data

Thus, it appears that the pace of transition varies, and this may affect the degree to which copper-based wholesale products are likely to provide a constraint on the pricing of higher bandwidth technologies.

Such a constraint may be weakened more widely across once FTTH, and bandwidth or latency intensive services are prevalent, and significant migration away from copper has occurred. The process will ultimately end in the switch-off of copper infrastructure, which is already progressing in countries such as Estonia, Spain and Sweden (rural areas). However, in the intervening period, the Swedish experience (as well as experience with PSTN switch-off) illustrates that a portion of customers may remain on the legacy technology despite pricing incentives to switch.

Feedback from stakeholders

In the responses to the Commission's consultation on the Review of the Relevant Market Recommendation, some stakeholders indicated that future markets should be segmented by speed, and that the segment for access to VHC broadband speeds should not be included in the list of relevant markets as it tends towards effective competition, or should face targeted regulation in those areas where competition has not been achieved. Some respondents also noted that copper-based services are no longer substitutes for fibre-based services. In the workshop with NRAs, this view was echoed by some NRAs which had seen significant migration from copper/lower bandwidth towards VHC services.

However, feedback following the March 2020 stakeholder workshop, highlighted that access seekers and alternative fibre investors for the most part consider that the migration from copper will take considerable time, and therefore is not relevant for this review period.[322] This view was also shared by NRAs in countries where copper-based technologies remain in widespread use.

Conclusions

The pace of migration towards all-fibre/wireless networks in Europe is likely to vary. In cases where copper is no longer acting as a constraint on the pricing of higher bandwidth technologies and/or forced switch-off of the copper network is imminent, NRAs should consider separating out copper and potentially FTTC/VSDL services from higher performing broadband access technologies. Consideration of the copper market in this context could focus on how to address the migration and phase-out of access obligations on legacy technologies in a manner which supports competition and protects the interests of vulnerable customers as well as businesses and public services which are reliant on analogue equipment.

5.2.5.5 Should mobile and/or wireless technologies be included in the relevant market?

NRAs have in general not considered that mobile or wireless technologies are in the same relevant retail or wholesale markets as fixed broadband access technologies, due to differences in the pricing and capabilities of these products, and the trend for customers to maintain fixed alongside mobile connections.

However, as discussed in section 5.1.3, there are some exceptions – notably Croatia, in the context of hybrid products and Austria (temporarily in the market for wholesale broadband access). Substitution of mobile and/or wireless technologies with fixed infrastructures has tended to occur in circumstances where fixed infrastructure has not been upgraded to the most performant technologies, thereby narrowing the capability gap.

The deployment of 5G FWA may again raise the question of whether wireless technologies may substitute at least partially for fixed technologies, increasing the scope for competition in the market. Such substitution may be more likely in rural areas where fixed bandwidths are limited and/or in countries where only partial upgrades have been made rather than a

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322 In ECTA's view, it is also questionable whether the phasing-out of copper will progress as quickly as planned, mainly because of high capacity technology upgrade options but also because of slow replacement of copper by fibre. Open fiber in this regard thinks that incumbents will continue to have a pivotal role in the future, extending the duration of copper services. Open fibre believes that copper networks will continue to exist for the next 5-10 years. They stress that the short length of the secondary network will leave FTTC to be competitive for a longer time in some countries. It is therefore too early to define general switch-off plans for copper. 1&1 also consider that copper-based lines will continue to play a significant role in the long term. Eurofiber has a similar view noting that maybe in 5 years' time a conclusion can be drawn whether there will be a need for a separate VHC market. Danks Energi disagrees with DBA's proposal to exclude the copper/FTTC technology as part of VHC broadband. According to Dansk Energi there is a chain of substitution between a significant part of the copper/FTTC lines and coax/fibre as most copper/FTTC lines still support the peak bandwidth demand. Liberty Global considers that copper networks remain highly relevant in today's market and continues to exert considerable competitive pressure to VHCN.

transition to FTTH. There is already evidence of significant FWA take-up in Italy, which may be linked to these factors. However, with the exception of very rural areas, for which wireless access may provide a long-term replacement for copper, there is a possibility that any substitution between FWA and NGA may prove temporary as FTTH deployment accelerates.

Feedback from stakeholders

In the context of the Commission’s consultation on the Review of the Relevant Market Recommendation, some respondents argued that 4G and 5G could be considered substitutes for today’s Next Generation Access (NGA) networks and that fixed – wireless hybrid products could become more relevant. However, other respondents argued that even though 5G will be one of the main technological trends for the coming years, it will not affect the definition of relevant markets. Feedback received from stakeholders in the context of the March 2020 stakeholder workshop suggested that access seekers do not see 5G as a viable substitute for fixed broadband connectivity. ECTA also noted that it considers that medium or high capacity FWA might hinder FTTH deployment and cable upgrades.

Conclusions

When they see evidence of FWA products offering equivalent functionality and being used by customers interchangeably with fixed broadband, NRAs should consider whether FWA should form part of the relevant market on the basis of direct substitution or on the basis of indirect constraints, as discussed in the context of cable. However, they should also consider the degree to which any such substitution or constraint is likely to be enduring in view of customers’ usage of and/or interest in bandwidth intensive applications and expected enhancements to the performance of fixed technologies.

5.2.5.6 What is the scope of the wholesale market for dedicated capacity?

Definitions in the current Relevant Market Recommendation

The explanatory memorandum accompanying the 2014 Recommendation on Relevant Markets[323] distinguishes leased lines from mass-market connections by their ability to provide dedicated, and uncontended connections, and symmetrical upload and download speeds. It notes that leased lines may be provided using a range of technologies, and highlights that while legacy leased lines were usually point-to-point connections, leased lines are increasingly offered over Ethernet-based technologies, allowing more flexibility, normally at a lower cost, and can be both PtP and PtMP.

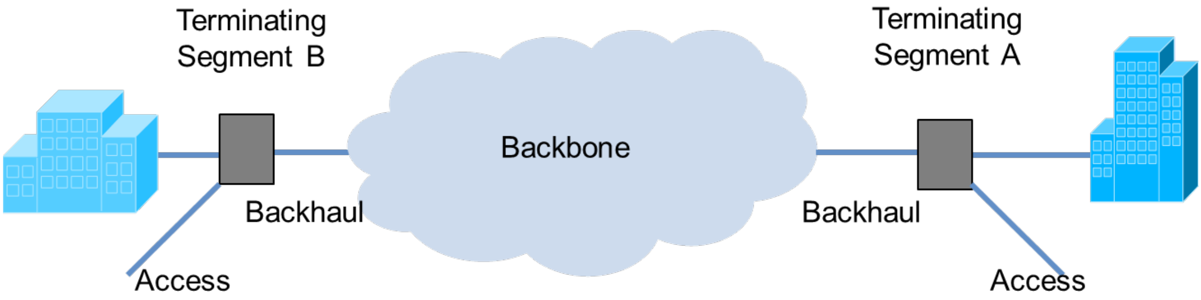
The explanatory note of 2014 observes that what constitutes a „terminating segment“ will depend on the network topology specific to give member states, but that most member state

323 Paragraph 4.2.2.3

have defined terminating segments of leased lines (as distinct from trunk segments) as the „part between end-users' premises and the closest exchange of a service provider".

This is essentially a technological definition of what is meant by a terminating segment, and can be represented, as shown in the following diagram, in a similar way to the way in which mass-market connections are characterised, with an "access element", which is specific to the building to be reached and a backhaul segment in which traffic is aggregated and transmitted to the backbone network of the carrier concerned.

Figure 5-25: Leased line terminating segments



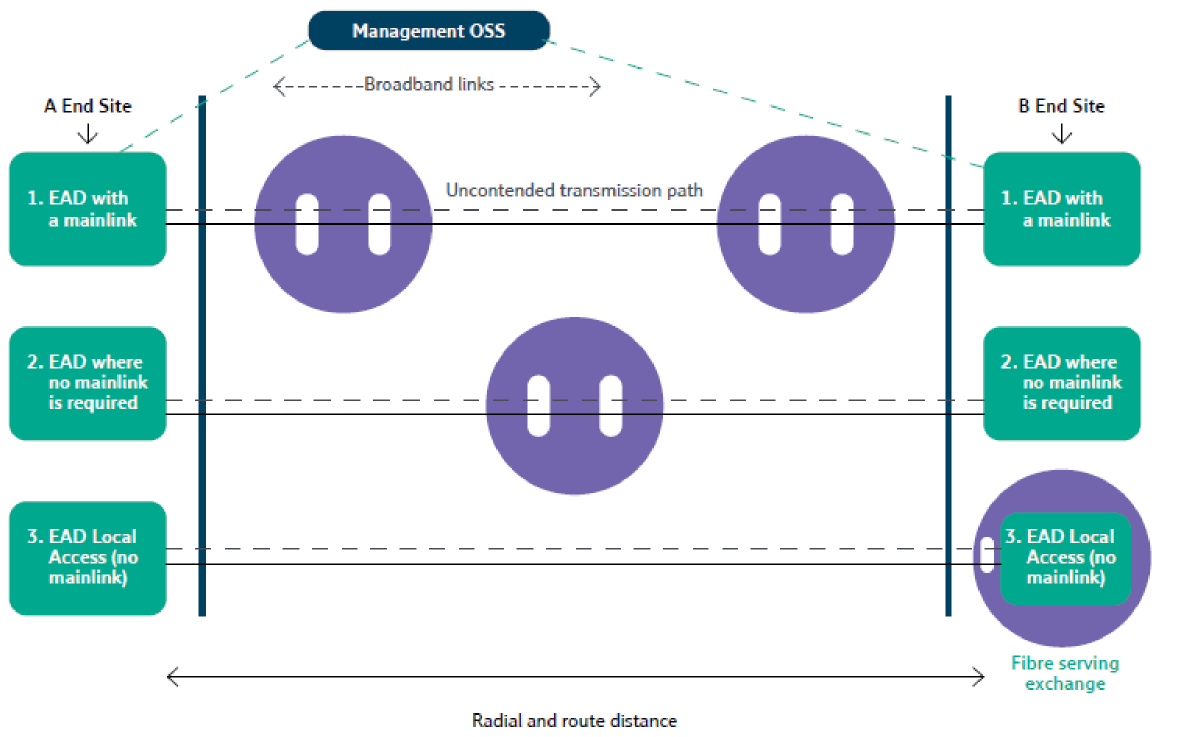
Source: WIK-Consult

National practices

Leased line offers in different countries differ regarding the location of the access point, and the degree of aggregation this entails. For example, in the UK local access point to point Ethernet connections based on fibre are available from Openreach at multiple „fibre serving exchanges" (see EAD no mainlink), while uncontended Ethernet transmission can also be provided over longer distances using a „main link". In its analysis of business connectivity markets, Ofcom defines leased line „access" (the terminating segment) as a dedicated single link service connection to a point of aggregation, whereas inter-exchange connectivity (trunk segments) are defined as providing a service between points of aggregation (BT exchanges).[324]

324 Ofcom (2020, Para 6.91).

Figure 5-26: Openreach Ethernet Access Direct configurations



Source: Openreach https://www.ciz-openreach.co.uk/Business/content/139/Ethernet-Access-Direct-EAD-fact-sheet

Conversely, in countries such as Ireland, Belgium, the Netherlands and France, where virtual leased lines prevail, access seekers purchase different elements of the connection as a bundle, and can opt for different „classes of service“. Access is offered at selected Points of Interconnection. The KPN Wholesale Ethernet Access Service is illustrated below. One or two dedicated fibres are provided from the end user location to the Ethernet access node. A non-overbooked virtual circuit is used from the EANode to the WAP port, and the connection from the WAP port to the Point of Interconnection is in the form of a tie cable.

Figure 5-27: Handover point: KPN WEAS service

2.1 Service structure

WEAS provides one or more EVCs between an end-user access point (EAP) at the end-user location and the WSC's PoI.

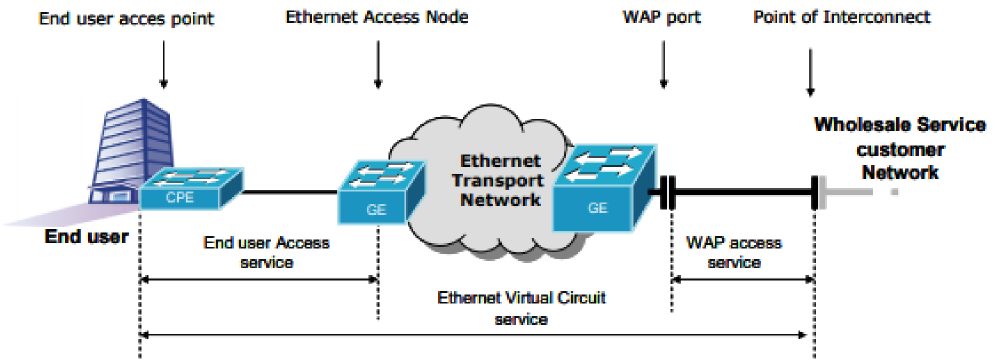


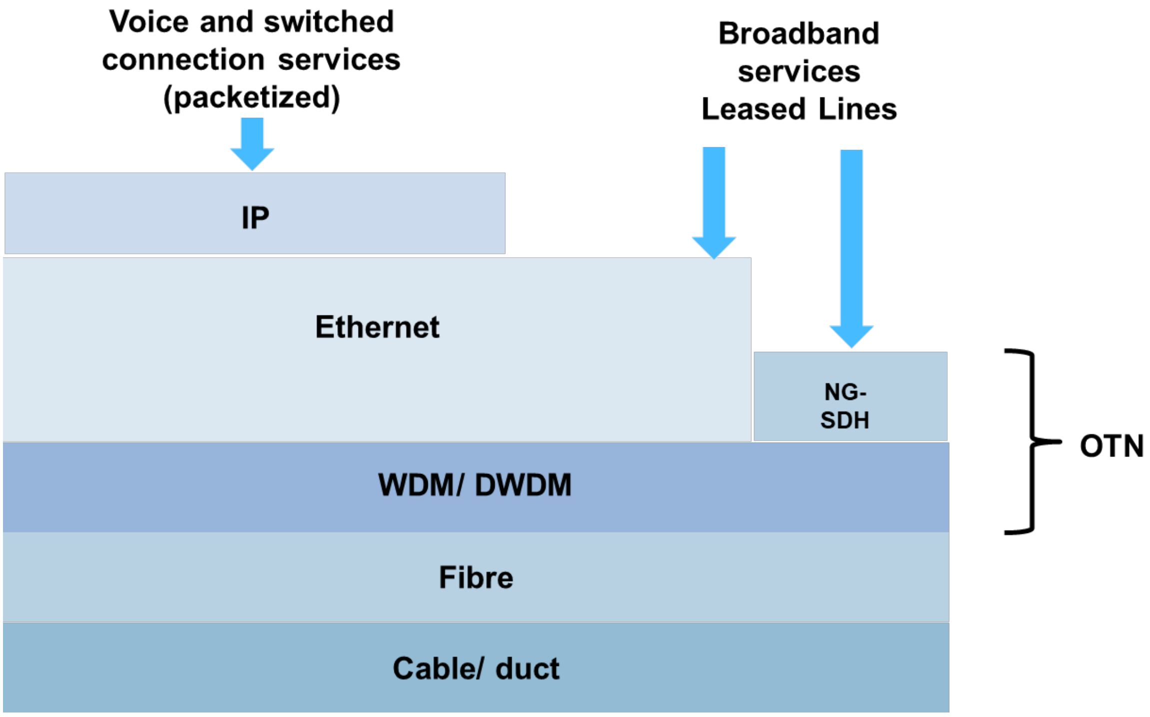
Figure 1: WEAS domain

The Austrian NRA meanwhile has defined terminating segments for leased lines by excluding "trunk routes" from the scope of the market definition. Trunk segments constitute connections between 43 cities.[325]

As demand for traditional interface leased lines declines (with decommissioning in some countries), Ethernet has become the prevalent interface for leased lines. However, this too could evolve for higher bandwidth leased lines. Rather than relying on Ethernet, leased lines of 1 Gbit/s or more can be more efficiently connected to the underlying OTN (Optical transport network or its DWDM (Dense wavelength division Multiplex) functions), because it is typically inefficient to reserve large bandwidth shares for leased line traffic in the more expensive Ethernet or IP switches. The position of the OTN in the value chain is shown in the diagram below. "Optical interface" leased lines at higher bandwidths have indeed been made available by incumbents in countries such as the UK, Sweden and the Netherlands, and are used instead of Ethernet in this context.

325 RTR M4 analysis 2016/17. The German NRA also excludes backbone segments from the market as these are considered competitively supplied.

Figure 5-28: General network protocol stack



Source: WIK-Consult

Stakeholder feedback

Few stakeholders commented specifically on the distinction between trunk and terminating segments in the context of the Commission's consultation on the review of the Relevant Market Recommendation. However, in comments made in the context of the March 2020 stakeholder workshop, ETNO noted that the dividing line between trunk and terminating segments should be left to NRA as geographic and network structural parameters differ significantly. Meanwhile, business provider COLT proposed that a terminating segment should be defined as a connection serving an end-user location (irrespective of distance), while a trunk segment connects two parts in a network. 1&1 observed that the border between a trunk and a terminating segment is where a given number of customers share a line in relation to the total volume. According to 1&1, they consider that the BNG should be considered as the boundary of the terminating segment for "leased lines" provided via FTTC/VDSL vectoring,[326] whereas in case of mobile telephony, 1&1 considers that the boundary between terminating and trunk segments would fall between the segment connecting masts and the core network.

326 Vectoring technology is used in Germany to provide low speed leased lines of up to 40Mbit/s. However, the bandwidth and quality specifications of such lines would not meet requirements for the high-end business market.

Conclusions

In the case of point to point lines, “local access” terminating segments of leased lines can be defined with reference to the portion of the service extending from the end-user site[327] to the fibre serving exchange. Alternatively, the terminating segment can be defined through the exclusion of “trunk segments” linking major conurbations or interconnection points.

From an economic perspective, it may be helpful for NRAs to choose the method for defining the terminating segment which best reflects the prevalent network architecture and distinguishes links for which there may be (outside major cities), limited competition in supply. Noting that a ladder of investment may exist for dedicated circuits as well as for mass-market fibre, elements for which access is made available should be as disaggregated as possible to enable the use of own-built or competitively supplied backhaul.

Ethernet (layer 2) is likely to be the prevailing interface for terminating segments of leased lines for bandwidths of up to 1Gbit/s. However, as demand for higher bandwidth increases, there is likely to be increasing take-up of WDM leased lines (sometimes referred to as “managed dark fibre”. These solutions should therefore also be considered by NRAs as a potential substitute or replacement for layer 2 Ethernet.

5.2.5.7 Should dark fibre be included within the relevant market for dedicated connectivity?

Most NRAs have restricted the scope of market 4 to active wholesale products such as traditional and ethernet interface leased lines. However, dark fibre is available on commercial terms from certain operators (such as business focused providers or municipal network providers) in most countries, and at least two NRAs have included dark fibre within the business connectivity market as a substitute for Ethernet leased lines.

In its 2019 Business Communications Market Review, Ofcom concluded based on a supply-side analysis that dark fibre, when used to supply or self-supply leased line access services, was in the same product market as leased line access services. This view was confirmed in Ofcom’s January 2000 consultation on its forward-looking approach to market analyses.[328] The reasons given[329] were that:

- When networks are already connected with fibre, they could switch quickly and at minimal cost between dark and lit fibre in the event of a SSNIP. Ofcom noted that the main dark fibre providers supplied both dark fibre and active leased line services; and

327 This may be a business premise, or the site of a small cell or IOT device
328 Ofcom (2020).
329 Ofcom (2020, para 6.78).

- Where suppliers are not already connected, dark fibre providers are equally able to supply active leased line access services as any other supplier of leased line access as the incentives to extend their network would be similar for both services.

However, although dark fibre is included within the scope of the market for leased line access (and inter-exchange connectivity), regulation of dark fibre is restricted in the access segment to areas where there is unlikely to be material scale commercial deployment by rival networks to BT (excluding so-called “high network reach” areas.

In its 2018 Decision,[330] the Austrian regulator TKK concluded that the scope of the “high quality access” market should include both terminating segments of leased lines with Ethernet interfaces and dark fibre ends. TKK included dark fibre within the relevant market on the basis that there was increasing demand for dark fibre due to the technical and price flexibility it offers in terms of bandwidth adjustments. It also said that dark fibre was often used by access seekers as a substitute for Ethernet terminating segments of leased lines despite the need to purchase additional active equipment.

TKK identifies two market segments, at speeds lower and higher than 10Mbit/s, and for the market for higher speed high quality access, identified differences in the competitive conditions applying within and outside 355 communes. TKK concluded that the segment outside 355 communes deemed to be prospectively competitive met the 3 criteria test, and it imposed remedies including an obligation to supply dark fibre in cases where the infrastructure exists and the incumbent retained a technical operational reserve of two fibres.

The use of dark fibre for business connectivity as an alternative to Ethernet leased lines has also been confirmed in countries such as Sweden where dark fibre is available from municipal network operators as well as the incumbent,[331] and was one of the reasons given by PTS for the deregulation of the high-quality access market in Sweden.[332]

Notwithstanding the cost of purchasing equipment, substitution by access seekers and end-users to use dark fibre in place of Ethernet connectivity may be explained by the higher quality dark fibre can provide, as a result of the potential to integrate the lines in the access seeker’s own network operation systems and/or because of the capability to use different Ethernet protocol parameters (i.e. larger packet sizes) than those offered by the access providers or even different protocols (others than Ethernet) instead of encapsulating these in Ethernet frames.

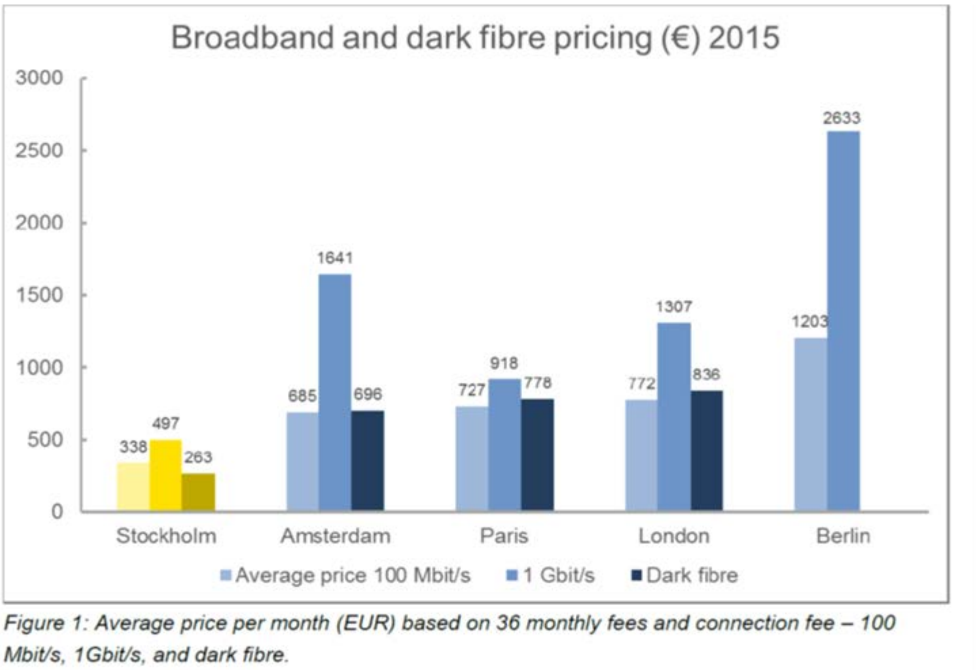
330 See Case AT/2018/2017.

331 In an interview conducted for this study in February 2020, Stokab noted that its point to point dark fibre infrastructure was procured directly by some businesses and public administrations as well as being used for the provision of leased lines or backhaul purposes by operators.

332 PTS concluded in its 2016 analysis that market 4 (defined as including high quality Ethernet connectivity) did not meet the 3 criteria test, inter alia because operators wishing to supply wholesale high-quality capacity services to business end-customers can buy regulated (passive) access to Telia's copper and fibre access network as well as from local municipal networks, so that access to the local access network (to which end-customers are usually solely connected) is not a barrier in itself.

In a 2015 price benchmark based on a “mystery shopping” methodology, [333] United Minds found that dark fibre connections were available at similar prices to 100Mbit/s symmetric business connections across four cities where dark fibre was available on commercial terms. Gigabit symmetric broadband connections were priced at a significant premium, which may explain why operators and end-users requiring significant bandwidths might choose dark fibre in place of active connections.

Figure 5-29: Broadband and dark fibre pricing across six European cities, 2015



Source: United Minds (2015).[334]

Feedback from stakeholders

The inclusion of dark fibre as a substitute for Ethernet leased lines was opposed by ETNO and incumbent operators responding to the Commission’s consultation, as well as by alternative investors in fibre access networks such as BREKO, on the basis that it is an input to downstream leased lines, and regulating it could undermine incentives to invest in FTTH networks. Business operator COLT suggested that dark fibre and leased lines often serve different needs as non-bandwidth-based pricing (associated with dark fibre) enables innovation and competition. COLT also noted that the degree of competition is also likely to differ, given that mobile operators often share masts or RANs, whereas single-tenant business premises only house one customer (further discussed in the context of the section on backhaul).

333 United Mind (2015).
334 United Mind (2015).

Conversely, access seekers including ECTA and 1&1 argued for the inclusion of dark fibre within market 4, on the basis that it allows for customer-independent product design, which is important for innovation.

Conclusions

There is evidence from a number of countries (notably including those with point to point fibre deployment) that operators (and some larger businesses) purchase and made use of dark fibre (fibre unbundling) in a similar manner to the way in which they would use active leased lines. Moreover, from the supply-side there are relatively low barriers to a dark fibre supplier offering leased line connectivity and vice versa, and many commercial suppliers of dedicated capacity make both options available in the areas in which they are present.

On this basis, we conclude that dark fibre and active leased line services offered at similar connection points may be in the same wholesale market.[335] There may however be a case to examine whether competitive conditions for dark fibre vary depending on the use case, and associated differences in revenues.

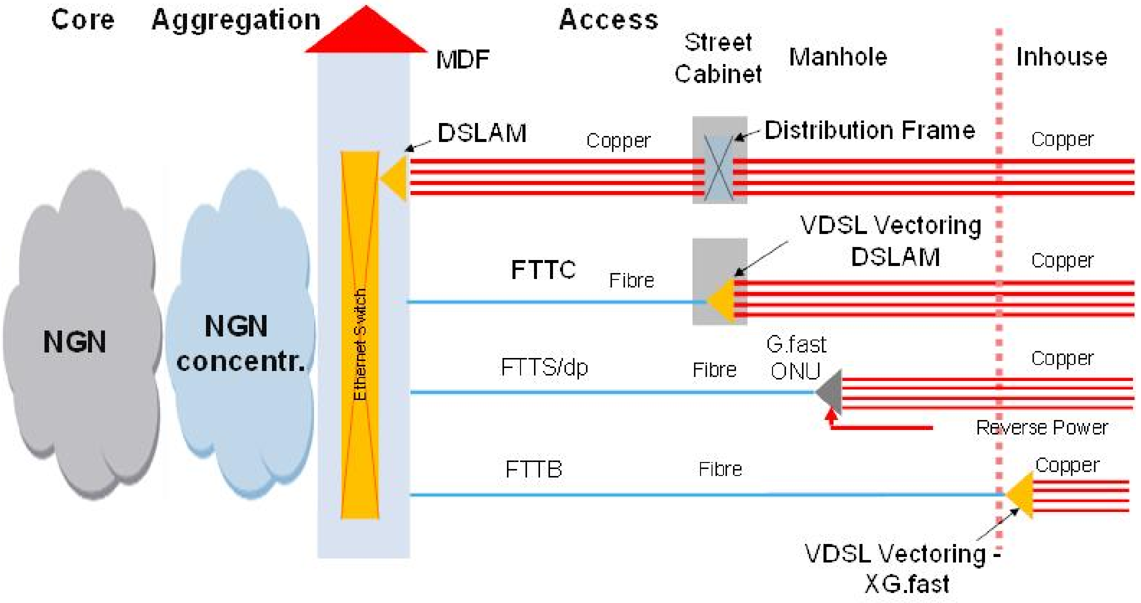
5.2.5.8 Is backhaul a specific market, or does it fall within the market for dedicated connectivity?

In a telecoms network, backhaul refers to the intermediate links between the core/backbone network and the connections at the edge of the network linking end-users in the case of a fixed network, or base stations, in the context of a mobile network.

The location and length of the backhaul segment may vary depending on the network architecture. In cases where FTTC or FTTdp (fibre to the distribution point) has been deployed, the fibre segment between the cabinet or distribution point and the MDF site may be referred to as backhaul, as traffic is aggregated over this link. This connection is however considered to be in the “access” portion of the network for the purposes of identifying the boundary between wholesale local access and wholesale central access.

335 As discussed in section 5.2.2, PIA can be considered as a separate market from access to downstream networks (including dark fibre) in cases where telecoms PIA is a significant driver of infrastructure competition and new entry. An entrant might consider PIA and dark fibre as alternatives before making an investment, but substitution between the two is unlikely once infrastructure is deployed or long term agreements have been made to lease dark fibre. Thus distinct markets for PIA and downstream dark fibre/dedicated capacity might be found in this case. Where PIA is not relevant or cannot readily be provided, the downstream service - dark fibre could constitute an alternative.

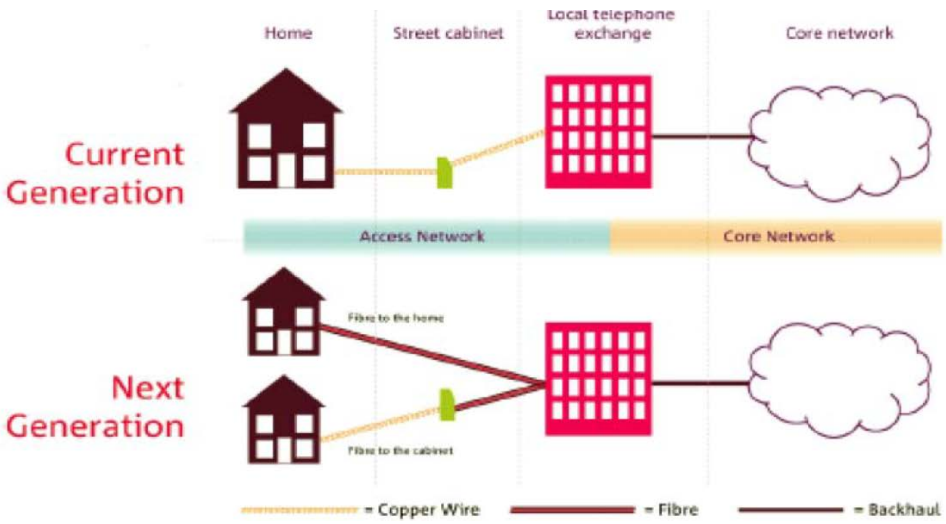
Figure 5-30: Architectures within an NGA



Source: EC 2016 Communication "Towards a European Gigabit society"

Backhaul also more typically refers to the fibre aggregation links connecting the MDF (or ODF) site to the core network, as shown in the following diagram.

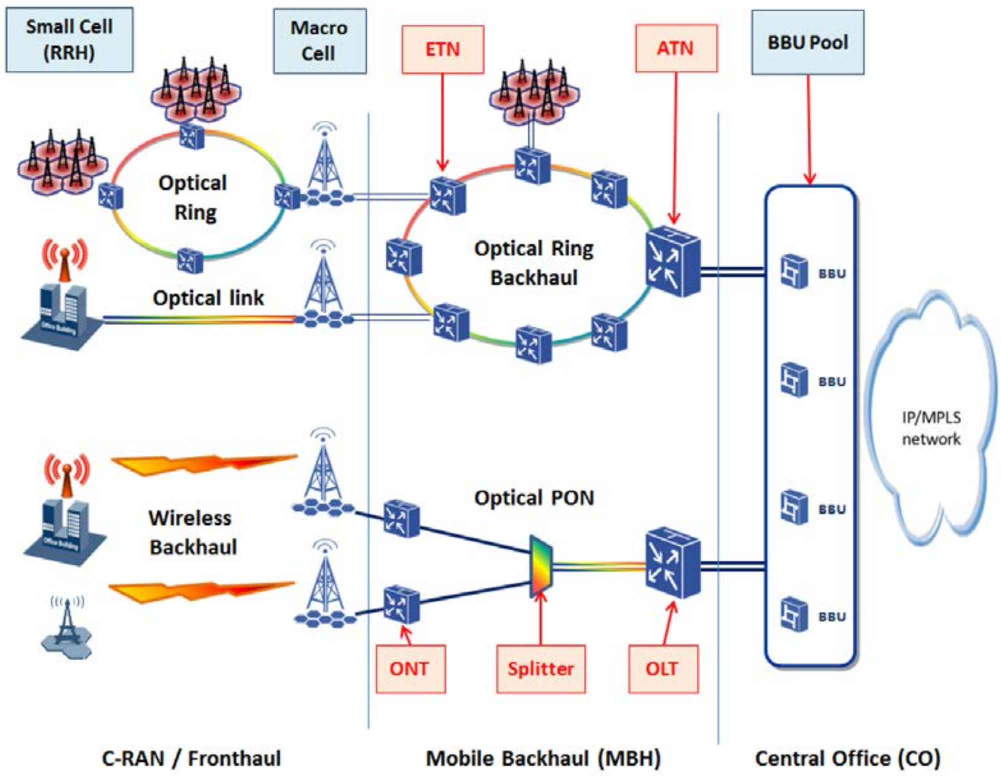
Figure 5-31: Next generation networks architecture



Source: Ofcom

Backhaul is also used to connect mobile base stations, and a further connection will be needed to link small cells. The following figure illustrates potential architectures for 5G mobile networks. The term "fronthaul" has been used in the context of mobile networking to distinguish the network portion separating the radio head controllers from the antenna locations. However, this network segment is effectively also a “backhaul” connection in terms of the role that it plays within the network hierarchy.

Figure 5-32: Crosshaul network architecture for future 5G mobile networks



Source: Haddaji, Bayati et al 2018 Backhauling-as-a-Service (BHaaS) for 5G Optical Sliced Networks: An Optimized TCO Approach

As discussed in section 2.6.9, backhaul links (especially for fixed access, and increasingly for mobile access), require very high and symmetric bandwidths, and high degrees of reliability and redundancy.

Various solutions can be used for backhaul, but interviews suggest that fixed and mobile operators prefer to self-construct or buy “dark fibre” backhaul rather than purchasing active links (leased lines), due to the flexibility and scalability offered by dark fibre, the potential to use dedicated mobile radio network protocols, and the potential for the leasing operator to use their own active equipment and make use of all available wavelengths. It is possible in some cases to make use of wireless connectivity for mobile backhaul, and interviews conducted by WIK suggest that around 50% of LTE base stations operated by non-incumbent operators make use of wireless connectivity. However, requirements for fibre backhaul for mobile are expected to increase in the context of 5G, and wireless is not expected to offer a substitute for fibre backhaul for 5G in cases where high bandwidths and a high degree of reliability and low latency are required.

The material and specifications for the high capacity fibre links used for fixed and mobile backhaul do not materially differ from those used for the highest grade leased lines (or dark fibre) provided to end-users such as large business premises. The distinction rather lies in the use case and associated location for delivery of the service. Thus, typically the same product is used for end-user and backhaul connections, although there are some examples where active leased line products specifically for mobile backhaul have been defined,[336] and Nokia is offering GPON network components which support 5G front/backhauling.

The availability of dark fibre for backhaul in different network segments by the incumbent and alternative suppliers in selected countries is illustrated in the following table. Dark fibre connections for backhaul are available on a commercial basis from specialist business access providers and/or utilities in many countries. However, the geographic coverage of these providers is typically limited. Beyond the coverage of such providers, fixed and mobile alternative operators typically rely on self-built dark fibre backhaul (which may be constructed with the aid of duct and pole access), or on regulated access to dark fibre backhaul provided by the incumbent.

Table 5-10: Main dark fibre suppliers by segment

	Main DF suppliers	Rationale for offers	DF in access network	DF for business access	DF from SC/MDF/ODF (fixed backhaul)	DF as mobile backhaul
Austria	A1 Telecom Austria strongest coverage	regulated in non competitive areas otherwise commercial offers	√	√	?	√
	Cable, utilities, infrastructure companies	non regulated, spare capa	√	√	√	√
France	Orange	Regulation	x	x	√	√ (in conjunction with fixed)
Germany	Deutsche Telekom, strongest coverage, no dark fiber supply	regulation, no commercial DF offers	x	x	mandated from SC as subsidiary auxiliary service to SLU, if duct access not available	x
	Regional and City Carriers, utilities, infrastructure companies	spare capacities, commercial interest	√	√	√	√
Japan	>30 suppliers of DF NTT largest: 77% share, KDDI also regulated Utilities and transport: commercial DF	Regulation Most likely unused capacity in utility networks	√	√	√	√
NL	KPN; ancillary DF to SLU since 2006, FTTH ODF since 2009 (to nearest node). Usage restricted.	Regulation	√	x	√	x
	Eurofiber: commercial DF since 2000 (no restriction of use) - also regional utilities	Eurofiber: venture capital	√	√	√	√
Sweden	Telia (incumbent)	Regulation + competitive threat	√	√	√	√
	Municipal carriers e.g. Stokab - fibre available from more than half municipalities	Wholesale only DF business model	√	√	√	√

Source: WIK-Consult, research conducted in 2017

It should be noted that regulation of backhaul is common in Europe. However, the approaches to regulating it, and the potential to use regulated *dark fibre* backhaul for fixed

336 Orange offers a specific service for mobile backhaul: Core Ethernet Mobile 2 (CEM 2). The poduct connects antennas to operator central offers with delivery at 24 regional PoPs. The product is distinguished from end-customer Ethernet with reference to the connection point (antenna locations) and higher quality technical specifications and mobile connectivity varies. A comprehensive benchmark of the remedies that can be used for mobile backhaul is included in a 2017 BEREC study on convergence of fixed and mobile networks.[337]

Backhaul as an associated facility

Dark fibre has been mandated as an "associated facility" to SLU, LLU and/or ODF access in the WLA market (market 3a) in a number of countries, including Sweden, Germany, the Netherlands, Spain, Italy and France.

Applicable regulations in some countries including Sweden and the Netherlands, assume its use is restricted to providing fixed broadband, as mobile backhaul was considered to be competitively supplied. This was also initially the case in France. However, in 2015 Iliad launched a dispute resolution proceeding before ARCEP asking for the contract to be modified to enable them to use regulated dark fibre backhaul also for mobile. ARCEP upheld Iliad's complaint[338] and required Orange to remove restrictions on the use of regulated dark fibre backhaul for mobile services, on the basis that networks were converging and that Iliad was installing fibre in the access network for both fixed and mobile broadband. Moreover, ARCEP noted that varying the tariffs for dark fibre depending on the use and nature of the connection were contrary to objectives for "effective and fair competition", "development of innovation" and "technology neutrality". Regulated dark fibre backhaul in France can also be used in connection with fibre terminating segment access, or in connection with duct access – where operators build the "last mile" fibre for corporate or mass-market use.

In Sweden dark fibre backhaul is mandated as an associated facility to unbundled access and must be provided up to distances of 50km. Although the Swedish incumbent Telia was required to provide dark fibre backhaul only for the purposes of fixed broadband, as of 2017 the unit supplying backhaul (Skanova) did not restrict the use of its dark fibre products as regards mobile backhaul or differentiate the terms offered for mobile as opposed to fixed backhaul.

In its 2018 wholesale fixed access market review, the Dutch regulator ACM mandated dark fibre backhaul in connection with ODF access (fibre unbundling), to connect CityPoPs to more central aggregation points, which are typically local network locations in the KPN network where MDF access and/or VULA are offered. ACM justified the backhaul obligation on the basis that there were some CityPoPs serving only a few thousand or even hundreds of households, whereas it assumed that the business case for alternative operators to use ODF access would depend on gaining access at aggregation points connecting at least 1,000 households. There is however, no obligation for KPN to make backhaul available for mobile purposes.

337 BEREC (2017a).
338 ARCEP (2017).

A challenge which may occur when regulating dark fibre backhaul as an associated facility in connection with local access, is that its use may be intrinsically considered to be linked to the purpose for which the linked access product has been mandated. This may not be consistent with trends towards converged infrastructure. Moreover, when dark fibre backhaul is mandated as an associated facility, it may be mandated on a nationwide basis without consideration to the competitive situation in the supply of backhaul, and any potential regional variations in this competitive situation.

Backhaul regulation in connection with “high quality” access

At least two NRAs, Austria and the UK, have chosen to mandate dark fibre backhaul in the context of the “high quality” access market, rather than as an associated facility. A common feature in doing so, is that backhaul has been considered without reference to the use-case, and is thus available for fixed or mobile use, and regulation has been limited to geographic areas in which such backhaul cannot viably be self-constructed or purchased in a competitive market. Moreover, a majority of the other NRAs reported in the context of the BEREC 2017 study on fixed mobile convergence[339] that products regulated in the context of “access to terminating segments of leased lines” could also be used for mobile backhaul. However, in most cases, it is understood that regulation is restricted to “active access” rather than dark fibre.

In the UK, Ofcom set out its approach towards the “high quality” market in its 2019 Business Connectivity Market Review.[340] Ofcom distinguished a separate market for business connections delivered via “Contemporary Interfaces” (CI) and further segmented this market between CI access and CI “inter-exchange” connectivity services. All bandwidth were included. CI inter-exchange connectivity services are routes between points of aggregation, i.e. network nodes, BT exchanges and most data centres, typically made up of backhaul and core connections. Ofcom notes that whereas access circuits are limited to individual business (and mobile) demand, CI inter-exchange circuits combine the demand of consumers (primarily residential broadband), businesses and mobile operators. In addition, the bandwidths of inter-exchange circuits are higher. Such circuits would likely be classified as “trunk” segments in the context of distinctions made between trunk and terminating segments in the definition of relevant markets.

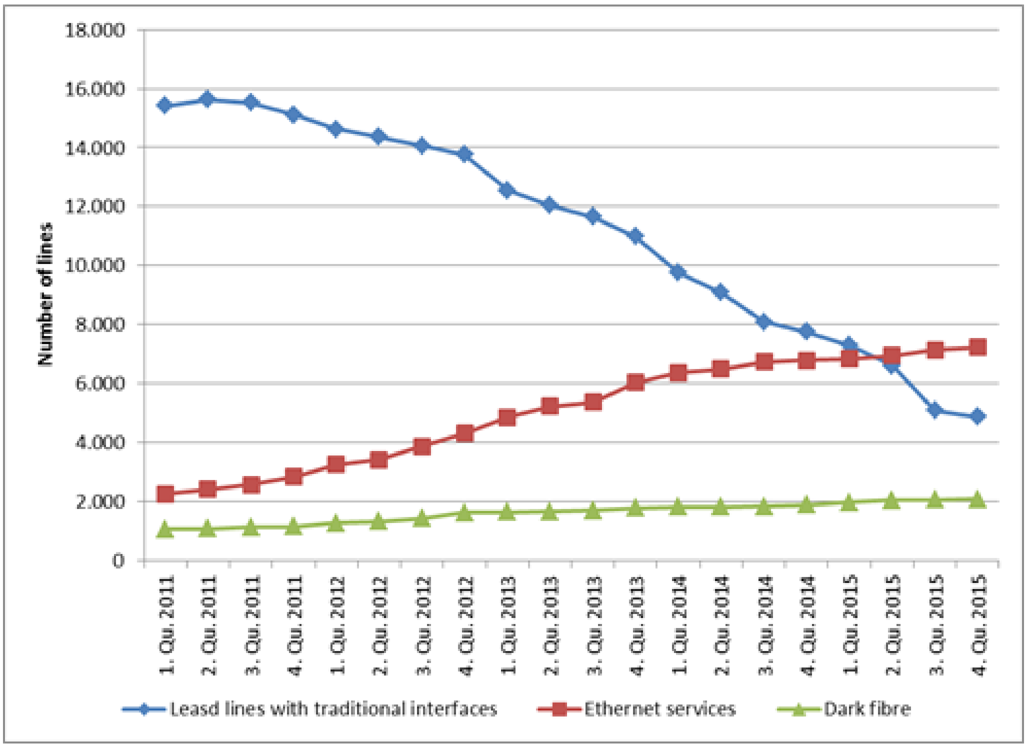
Ofcom conducted assessments of the competitive conditions in these inter-exchange circuits on a route by route basis, and identified those for which BT faces no competition from rival operators and there are no rival networks within 100m. Ofcom considered a distance of 100m from the exchange would make it unlikely for rival operators to construct their own connectivity, even in the presence of duct and pole access. Given the low likelihood of network competition for these routes, Ofcom imposed a requirement for dark fibre at cost-

339 BEREC (2017a, Annex 1)
340 Ofcom (2019).

oriented rates for inter-exchange circuits connecting to these locations.[341] Ofcom also noted that it was likely there would be other areas where duct and pole access would not be sufficient to support infrastructure-based competition, and committed to a further review of areas where dark fibre should be mandated in 2021. In parallel with mandating dark fibre inter-exchange connectivity in "BT only" areas, Ofcom also mandated access to active Contemporary Interface lines for backhaul, both in areas where only BT was present at the exchange, and where there was competition between BT and one other provider.

In Austria, the NRA has regulated dark fibre (alongside Ethernet connections) for mobile backhaul through applying access regulation to terminating segments (including dark fibre). Access is available for any purpose and to any point, therefore including base stations alongside business premises. In a presentation given in the context of the workshop held with BEREC for this study in January 2020, RTR reported that mobile network operators in particular were demanding dark fibre as a substitute for (and in preference to) Ethernet. 40-50% of wholesale demand reported was for mobile backhaul.

Figure 5-33: Trends is usage of dark fibre, Ethernet and traditional interface leased lines, Austria



Source: RTR

As with Ofcom, the Austrian NRA has limited regulation of dark fibre to areas in which it does not consider that there is competitive supply. In the 355 communes which TKK considered were effectively competitive, the incumbent's average market share was below 15% (and

341 Ofcom (2019, para 1.21).

less than 40% in every commune). Moreover, at least two operators with their own infrastructure offering Ethernet and/or dark fibre were present in those areas. However, Telekom Austria was typically the only supplier present in the communes where regulation was imposed.[342]

Unlike Ofcom, TKK did not identify “trunk” (inter-exchange) segments which were susceptible to ex ante regulation, as it considered that these segments are competitively supplied.

Competitive conditions for dark fibre backhaul

There is limited information available about the competitive conditions applying for dark fibre backhaul. From a theoretical perspective, there are a number of factors which could support a stronger case for competition in backhaul for mobile broadband (as well as fixed broadband) than exist for access lines for single companies. In particular, backhaul is associated with a number of retail mobile or broadband connections and therefore may support higher ARPUs than a single user connection. Moreover, network sharing or co-investment arrangements may reduce the cost to each operator.

It is true that many mobile operators self-supply or co-invest in mobile backhaul today. This could support the case for this segment being found to be competitive (as has been the case in a number of countries).

However, there are indications from a number of sources that the prospects for viable self-supply of mobile backhaul by multiple providers may be constrained in certain areas as the demand for bandwidth increases, and as 5G is deployed.

In its 2017 report on the convergence of fixed and mobile networks,[343] BEREC notes that data collected from MNOs suggests that most MNOs use a combination of fixed and wireless (mainly microwave) links to connect base stations, but that at that time, wireless technologies were the predominant mechanism to connect base stations, accounting for more than half of such connections in 2016. BEREC considered that it was reasonable to assume that the proportion of wireless connections was not evenly distributed, and that it was likely that fixed-mobile operators (such as the incumbent) would use fixed infrastructure for mobile backhaul more intensively than those without extensive fixed infrastructure. As regards the source of the fixed infrastructure, only 16 MNOs across 13 countries relied solely on their own infrastructure (which can be assumed to include incumbents), while others predominantly relied solely on leased infrastructure or a combination of own and leased infrastructure – with proportions of reliance on leased infrastructure ranging from 35-95% of the relevant connections. In many cases, commercial access was used, not only from electronic communication providers, but also others such as energy utilities. However, regulated access was used by some MNOs (variously under market 3a, 3b and 4) and a clear majority

342 Case AT/2018/2071.
343 BEREC (2017a) Report on the convergence of fixed and mobile networks BoR (17) 187

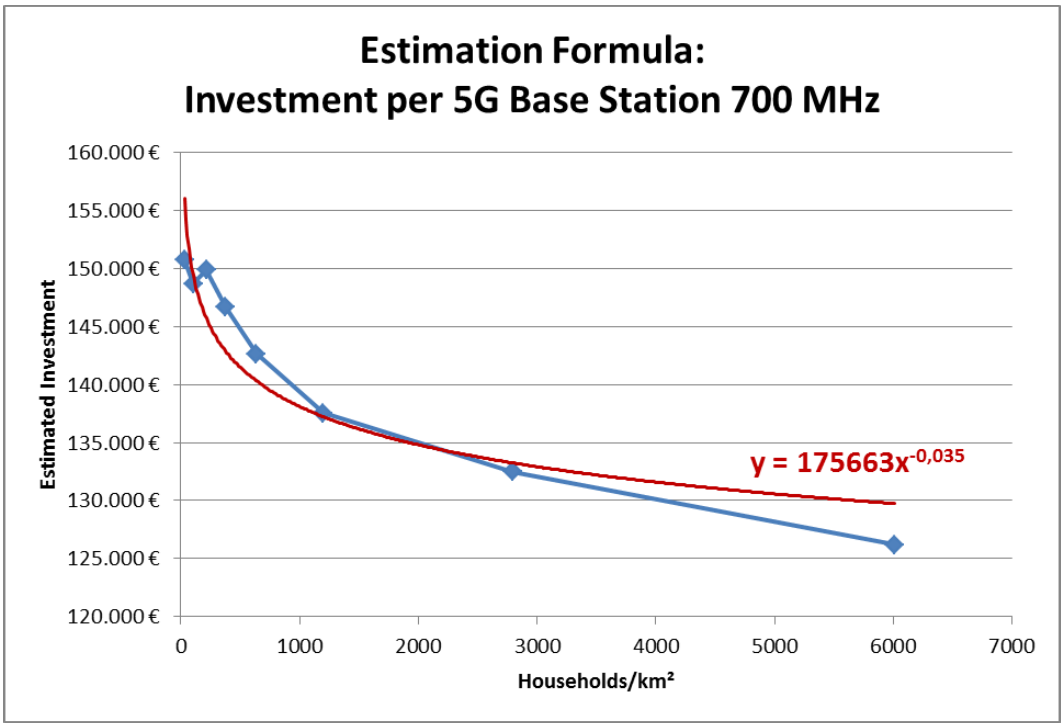
of respondents (presumably including most non-incumbent MNOs) noted that the existence of a regulated offer facilitated commercial negotiations, even where the regulated offer was not widely used.

In the context of 4G, non-incumbent MNOs have been able to utilize a combination of solutions for backhaul, which have allowed them to take advantage of wireless solutions, for example when regulated offers (e.g. for leased lines) are insufficiently flexible and commercially provided solutions are not available.

However, the move towards 5G is likely to require the upgrade of backhaul to many base stations currently served via wireless with fibre, and – in time – the deployment of additional cells (to support higher bandwidth, and accommodate the reduced propagation characteristics of 3.5GHz spectrum), which would also often require fibre connectivity. These developments will increase investment requirements associated with deploying mobile networks and could further limit the degree to which mobile backhaul can be self-supplied or duplicated by mobile operators without pre-existing extensive fibre networks.

Recently constructed models of the cost and profitability of deploying dark fibre backhaul for 5G in different geographic areas, such as that developed by WIK to identify areas of market failure for fibre in the context of CEF2, indicate that the cost of installing 5G base stations including fibre backhaul varies in relation to the population density (see below).

Figure 5-34: Investment per 5G base station in relation to population density



Source: WIK-Consult, Supporting the implementation of CEF2- SMART 2017/0018

This means that there is limited viability of fibre for mobile backhaul in certain more remote areas, and there are further areas in which the viability of deployment of fibre backhaul for 5G is marginal, implying that it would not be viable to install multiple connections. An illustration of the viability of deploying dark fibre to a 5G base station coupled with deployment of fibre to "socio-economic drivers" is illustrated within a NUTS3 region of Germany in the table below. A large proportion of the rural districts would only be viable with subsidies for the backhaul connections (FTTH is not viable at all), while in some other rural districts FTTH would need to be subsidized (implying no more than 1 VHC infrastructure). Even in the "no market failure" areas (dense rural) there is a presumption that the critical market shares required would preclude infrastructure competition.

Table 5-11: Degree of viability of 5G/SED connections by MPoP areas: illustrative NUTS3 region in Germany

NUTS3	MPoP-ID	Name	Regio Cluster	Households / km²	Missing Lines	Market Failure	Market Failure Category	Estimated Invest	Estimated Subsidy
DEE04	39000_2	Beetzendorf	8 Rural	16,0	850	YES	some market failure	3.708.630	3.226.534
DEE04	39001_2	Apenburg	8 Rural	14,6	515	YES	some market failure	2.279.415	2.208.975
DEE04	39003_2	Jübar	8 Rural	15,6	491	YES	some market failure	2.151.167	1.934.546
DEE04	39004_2	Köckte b. Gardelegen	8 Rural	9,3	374	YES	SED equipped with 5G	25.399	9.145
DEE04	39005_2	Kusey	8 Rural	12,3	663	YES	SED equipped with 5G	48.605	15.533
DEE04	39006_2	Miesterhorst	8 Rural	11,9	242	YES	SED equipped with 5G	24.403	7.886
DEE04	39007_2	Tangeln	8 Rural	8,3	316	YES	SED equipped with 5G	25.857	9.770
DEE04	39008_2	Kunrau	8 Rural	13,8	511	YES	SED equipped with 5G	23.848	7.242
DEE04	39009_2	Badel	8 Rural	10,7	376	YES	SED equipped with 5G	24.843	8.425
DEE04	3901_2	Salzwedel	7 Dense Rural	115,9	7.176	NO	no market failure	23.075.846	0
DEE04	3902_2	Diesdorf/Altmark	8 Rural	14,3	600	YES	SED equipped with 5G	23.717	7.096
DEE04	39030_2	Brunau	8 Rural	12,0	609	YES	SED equipped with 5G	24.380	7.859
DEE04	39031_2	Dähre	8 Rural	13,3	412	YES	SED equipped with 5G	23.997	7.411
DEE04	39032_2	Mahlsdorf b. Salzwedel	8 Rural	16,4	613	YES	some market failure	2.665.562	2.255.040
DEE04	39033_2	Wallstawe	8 Rural	10,1	292	YES	SED equipped with 5G	25.055	8.694
DEE04	39034_2	Fleetmark	8 Rural	11,7	518	YES	SED equipped with 5G	24.483	7.982
DEE04	39035_2	Kuhfelde	8 Rural	14,4	695	YES	some market failure	3.081.156	3.047.593
DEE04	39036_2	Binde	8 Rural	9,5	357	YES	SED equipped with 5G	25.305	9.020
DEE04	39037_2	Pretzier	8 Rural	18,7	747	MAYBE	some market failure	3.182.485	2.288.427
DEE04	39038_2	Henningen	8 Rural	12,1	387	YES	SED equipped with 5G	24.366	7.842
DEE04	39039_2	Bonese	8 Rural	9,3	337	YES	SED equipped with 5G	25.405	9.152
DEE04	39056_2	Klüden	8 Rural	8,0	283	YES	SED equipped with 5G	26.007	9.981
DEE04	3907_2	Gardelegen	7 Dense Rural	61,6	4.041	NO	no market failure	14.321.774	0
DEE04	39080_2	Kalbe/Milde	8 Rural	15,5	985	YES	some market failure	4.316.234	3.898.372
DEE04	39081_2	Kakerbeck/Sachs.-Anh.	8 Rural	9,8	379	YES	SED equipped with 5G	25.202	8.885
DEE04	39082_2	Mieste	8 Rural	16,3	838	YES	some market failure	3.644.810	3.089.039
DEE04	39084_2	Lindstedt	8 Rural	9,1	349	YES	SED equipped with 5G	25.508	9.291
DEE04	39085_2	Zichtau	8 Rural	9,8	572	YES	SED equipped with 5G	25.187	8.866
DEE04	39086_2	Jävenitz	8 Rural	12,4	560	YES	SED equipped with 5G	24.246	7.700
DEE04	39087_2	Jerchel/Altmark	8 Rural	10,1	534	YES	SED equipped with 5G	25.084	8.732
DEE04	39088_2	Letzlingen	8 Rural	6,8	587	YES	SED equipped with 5G	26.726	11.042
DEE04	3909_2	Klötze/Altmark	8 Rural	39,8	1.942	NO	no market failure	7.362.809	0
DEE04	39384_2	Arendsee/Altmark	8 Rural	23,4	1.430	MAYBE	some market failure	5.881.782	3.207.120
DEE04	**SUM or MID of MPoP**			**18,0**	**29.579**			**76.219.295**	**25.343.202**

Source: WIK-Consult, Supporting the implementation of CEF2- SMART 2017/0018

Network sharing could improve the economics of deploying 5G backhaul. However, the incumbent may not be incentivized to provide access to dark fibre or share its network in areas where duplication is not viable, if otherwise it could maintain a competitive (quality) advantage in comparison with its mobile competitors.

More generally, the prevalence of dark fibre backhaul remedies as an associated facility to Subloops unbundling, implies that NRAs consider that the competitive conditions for backhaul within the "access" segment e.g. from a street cabinet or first distribution point close to the customer, is subject to the same replicability restrictions as the procurement of a local access connection as a whole, at least as regards fixed broadband.

Moreover, when NRAs have mandated access to dark fibre backhaul from the MDF or ODF site (and extended their use to mobile backhaul as is the case in France), there is an implicit assumption that this network segment is also subject to competitive restrictions.

The blanket imposition of dark fibre backhaul remedies as an associated facility means that NRAs may not necessarily have assessed differences in competitive conditions across the national territory. However, there is also a presumption that competitive challenges may exist in at least some parts of the country.

Consultation responses and other feedback

A majority of respondents to the Commission's consultation consider that the market for wholesale high-quality access should remain in the list of relevant markets. One of the justifications that were given is that building backhaul infrastructure to reach relatively dispersed customers remains a bottleneck. Some respondents arguing for the inclusion of dark fibre within the scope of this market, noted its relevance for backhaul. For example, ECTA and 1&1 observed that dark fibre enabled a greater degree of control for the backhaul connections that would be needed for 5G. This echoes observations made by some MNOs in the context of the survey conducted by BEREC in 2016,[344] where the importance of flexibility and potential to expand capacity was raised as an important feature in mobile backhaul solutions.

Conversely, incumbents responding to the consultation mostly consider that high quality access for backhaul connections is or can be self or competitively provided. ETNO considered that wireless based solutions would be suitable for 5G and fibre would not be needed in every situation. ETNO also expressed concerns that regulation could be extended to mobile backhaul without an underlying competitive analysis as required by the EU legal framework.

Some alternative infrastructure investors also claimed that regulating fibre backhaul for 5G could jeopardise the investment needed for 5G deployment. For example, BREKO noted that the market for fibre backhaul to 5G base stations should not be regulated because fibre operators have a strong interest in co-operating with 5G-Network Operators, and should only be regulated when there is a problem. Imposing regulatory measures on FTTB/H networks under construction, would deter fibre roll-out and hinder the development of VHC-network connectivity.

Eurofiber noted more generally that fibre backhaul for 5G base stations does not constitute a new or separate market as these type of connections are no different than those supplied to

344 BEREC (2017a)

large businesses. They observed that both dark fibre and active connections are equally suitable in meeting connectivity demands and the choice ultimately comes down to a make or buy decision on the demand side.

Nonetheless, some stakeholders suggested that there could be differences in the competitive conditions applying to mobile backhaul in comparison with end-user connections. COLT observed that the degree of competition could differ because mobile operators often share fibres or bandwidth along with masts or RANs (in the context of network sharing agreements), whereas single-tenant business premises only house one customer.

Meanwhile, the FTTH Council observed that mobile operators could be expected to deploy their own backhaul infrastructure and expressed concerns that premature regulation on mobile backhaul could undermine incentives to invest on the part of mobile operators, and could deter them from building additional fibre for future use. Few stakeholders commented specifically on competitive conditions applying to inter-exchange connectivity (trunk) segments. However, COLT observed that inter-exchange connectivity could be an ancillary remedy to Markets 3a/b and 4, but that it should be considered whether supply was competitive or not. The FTTH Council noted that the key elements in the provision of inter-exchange connectivity are service guarantees, bandwidth, distance and the location or locations to be served. As regards competition, they noted that a significant number of routes continue to be only served by a single operator, and new entrants could not be expected to compete with the established operator across the whole of the territory of many markets.

<u>Conclusions</u>

There is a case to include dark fibre for backhaul (both fixed and mobile) within a relevant market for dedicated access.[345] This could replace the practice in some countries or regulating dark fibre as an associated facility to wholesale local access.

Access to dark fibre for backhaul is already mandated in a number of EU member states as an associated facility to LLU and/or ODF access (such as FR, SE, NL), while in others (e.g. AT, UK) it has been mandated in the context of the dedicated access/high quality market. Regulated access to dedicated active circuits which can be used for mobile backhaul (Ethernet or WDM leased lines) are also available in most EU member states.

As operators' networks become increasingly converged with fibre supporting both fixed and mobile connectivity, it may become increasingly difficult to restrict the use of backhaul to "fixed access". Moreover, the deployment of 5G small cells is likely to increase the need for fibre backhaul, even in the case of pure mobile deployments or deployments of 5G FWA, while certain IOT applications including smart city and connected mobility applications also require fibre backhaul.

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345 The demand for "dark" as opposed to "lit" fibre for backhaul is likely to increase as operators seek to address increasing data volumes that are likely to result from the widespread availability of FTTH and 5G applications (including IOT).

NRAs that have looked specifically at the competitive dynamics of backhaul, as a market in its own right (UK) or in conjunction with “high quality access” (Austria), have found that the competitive dynamics vary depending on the geographic area.

The competitive conditions for mobile backhaul may differ from that for end-user connections due to the potential to leverage revenues from multiple users. Mobile operators may also reduce the costs of backhaul by engaging in network sharing/co-investment or making use of their own mass-market FTTH infrastructure. Competitive conditions for this segment may also be improved by the potential entry of new actors such as road operators, which may act on a wholesale only basis or be obliged to offer access.

However, modelling suggests that even though the prospects for competitive deployment of mobile backhaul may be better than for remote single-user connections, there are still likely to be areas where only one fibre backhaul connection is viable (with or without subsidies), and where it is unrealistic to expect that multiple providers could deploy their own infrastructure. In these circumstances, vertically integrated operators with SMP in dedicated access may lack an incentive to share or provide access to dark fibre backhaul as doing so would provide a cost/quality advantage to their competitors. Moreover, additional demand for dark fibre for mobile access could emerge from stakeholders which do not have their own mass-market FTTH infrastructure and do not have the scale to engage in mobile network sharing, as vertical industries gain access to their own spectrum for the deployment of private networks.

The fact that the same dark fibre (or in some cases active access) product is used both to link end-users and mobile base stations, and indeed the fact that the same fibre connection may be used for both fixed and mobile backhaul, may make it difficult for NRAs to separate this use case and define a distinct market for fibre used for mobile backhaul. However, differences in competitive conditions between access provided to individual business end-users vs backhaul access (or indeed multi-tenant business access) could be addressed through varying the locations or circumstances in which dark fibre is mandated as a remedy in a market for dedicated access (this could be a subset of the geographic areas where leased lines are mandated), and potentially through the pricing regime applied. An appropriate geographic segmentation of markets and remedies should limit any negative effects on alternative investors deploying fibre and offering dark fibre backhaul to mobile operators, as areas in which there is competitive supply of such access may not be captured by regulation.

Competitive conditions in the “inter-exchange” (trunk) segment are likely to be more favourable than those in the “access” (terminating segment). However, experience (and modelling) suggests that there are still likely to be certain routes which are not competitively supplied. Where this is the case, NRAs could define a market for trunk/inter-exchange connections, and analyse the competitive conditions on a route by route basis.

5.2.5.9 Conclusions concerning the scope of wholesale data connectivity markets

Our preliminary analysis suggests that:

- Within this review period, it seems likely **separate market segments for wholesale local (physical or virtual access) and wholesale central access** will persist for the majority of member states. With the migration towards VHC, copper and FTTC are likely over time to fall within a different market segment from VHC capacity networks. Cable may fall within the scope of the WCA market, but is unlikely to constitute a direct substitute for FTTx or copper within the WLA market. Indirect substitution should however be considered. The inclusion of FWA should be considered on a case by case basis, noting that its capabilities are likely to fall short of the most performant FTTH deployments, but that it may substitute lower end VHC networks and may be the only viable access infrastructure in certain areas.

- Especially in countries where point to point FTTH has not been widely deployed and/or cannot be readily supplied or accessed by alternative operators, there may continue to be a distinct demand for high end dedicated or guaranteed Ethernet and WDM connections for business use. There is likely to be increasing demand for dark fibre as an alternative to active “leased line” connections, especially for the provision of fixed and mobile backhaul, and connections to large multitenant business premises. It may be justified in these cases to identify a **market for high quality dedicated connectivity encompassing connections used for both end-user access and backhaul (all use cases, and including dark fibre as well as active “leased line” connections).** The competitive conditions for different use cases may however vary, and should be considered in the context of regulatory obligations.

5.2.6 Assessment of the three criteria test

5.2.6.1 Wholesale local access

<u>High barriers to entry</u>

Deployment of broadband access networks involves significant economies of scale that give rise to high barriers to entry. Theoretical models suggest that in the absence of duct and pole access, widespread duplication of these networks is unlikely to be viable.[346]

In cases where duct and pole access is available and/or has been effectively regulated, there is evidence that infrastructure-based competition can emerge in more densely populated areas. This is apparent from the infrastructure competition that has developed in urban areas of Spain, Portugal France (see Table 3-2).

346 See for example WIK (2008).

However, beyond dense urban areas, widespread end-to-end network duplication has not been achieved in countries such as Spain and France, and is unlikely to be economically viable, even in the presence of duct and pole access. Moreover, models by WIK and other research organisations,[347] show that there are portions within most countries which are not economically viable in the absence of subsidies, implying that with subsidies only 1 VHC infrastructure would be viable.

Moreover, in some countries, duct and pole access cannot be made available due to the direct burying of cables, and thus the benefits of duct and pole access could not be realised.

As can be seen in countries such as Sweden, Denmark, Ireland and Italy, a degree of infrastructure competition can also emerge through the entry of operators such as utilities or municipalities which are able to (re)use their own duct and pole infrastructure. However, although there are some exceptions,[348] it is notable that in most cases deployment of such alternative networks have been targeted at zones or countries (such as Italy) in which there is only one pre-existing infrastructure.

Only two NRAs (in Romania and Bulgaria) have concluded that effective competition has been achieved in markets associated with wholesale data (WLA). However, the conditions in those countries differ from those of the majority of countries in Europe, for example in terms of the position of the incumbent, limited availability and quality of the legacy network, alongside a greater ease and relatively limited cost of laying new infrastructure.

We conclude that wholesale data access markets present high economic barriers to entry, at least in a majority of countries and for a majority of the national territory.

Limited tendency to competition

On the basis of current technologies, there has been a limited tendency in the wholesale local access towards more infrastructure competition, despite a decade passing since the first deployments of NGA broadband. Rather, in the presence of duct and pole access, infrastructure competition has developed around certain densely populated areas, and other solutions based on access or co-investment have had to be found elsewhere.

There are two developments which could in theory support the development of competition in this market.

5G FWA technology could potentially bypass the costly last metres. Trials have shown that speeds of 1Gbit/s can be achieved over 500m with this technology.[349] A market with three or four independent suppliers of 5G technology could thus potentially target the same customers, bringing similar levels of competition as those present in mobile provision.

347 See for example cost modelling conducted in the context of the study by Ecorys et al (2020) Supporting the Implementation of CEF2 Digital
348 For example in Stockholm, or in connection with the deployment of City networks in Germany.
349 See Fastweb (2019).

However, relevant spectrum has not yet been made available in all countries and it is not clear how this technology will be deployed in Europe. Moreover, the capabilities of 5G FWA fall short of the most performant FTTH infrastructures, as discussed in section 2.6.5, and thus it is not clear that it would continue to be a substitute over the coming decade as service demands and the capabilities of FTTH evolve.

Another potential development that could stimulate competition in this market would be if the main actors agree to co-invest on fair and reasonable commercial terms, in a manner that preserves their ability to distinguish services at the retail level. Commercial co-investment agreements have increased the scope of competitive provision of broadband access in countries such as Spain and Portugal. However, it should be noted that such agreements have not covered the whole of the territory, and are limited in scope in Spain – where the incumbent did not participate in the agreement. Indeed, the Spanish NRA took infrastructure based on swap arrangements into account in its geographic analysis of competition in VHC broadband. However, it still concluded that for a majority of households that the conditions for prospective competition were not met. Co-investment agreements cover a wider scope in Portugal, and have involved the incumbent as well as the cable operator. However, it should be noted that agreements occurred in the context of – and potentially under the threat of - regulation in this market.[350] Portugal is also distinct from other countries in that the incumbent may have had more incentive to participate as it not in pole position as regards the deployment of VHC infrastructure.[351]

It is not clear that the conditions would apply in other markets to support co-investment agreements across the territory as a whole. Alternative operators in fixed broadband markets typically start from a weak negotiating position, due to persisting imbalances in the retail market shares of alternative players in comparison with the incumbent, which can render equally shared investments to be risky and potentially unprofitable. Thus, we conclude that this market does not show a tendency towards effective competition across the whole national territory.

350 ANACOM raised the prospect of mandating virtual fibre access to be provided by the incumbent in a draft WLA market analysis in 2012. In the event, ANACOM never adopted or applied this market analysis. ANACOM explained that the market analysis had been overtaken by market developments including acquisitions and co-investment agreements which affected the competitive landscape

351 An unusual feature of the Portuguese market is that the incumbent originally controlled and invested in cable infrastructure, but became a challenger in the provision of high capacity broadband after that network was diverted in 2008 (becoming ZON Multimedia)

Insufficiency of competition law and other measures

The application of the third criterion in the three criteria test – the insufficiency of competition rules alone to address the market failure identified in a particular market[352] is generally presumed to be satisfied in the case where legal wholesale access remedies need to be prescribed (e.g., for dedicated access or backhaul) to redress a potentially anti-competitive situation. This presumption is derived from the following characteristics of decision-making under an ex post procedural framework, including:

- excessive delays in ex post decision-making;[353]
- the fact that, by definition, all ex post investigations under Article 102TFEU are very fact-specific and do not cover subsequent actions under the same measure (especially since the ex post investigation addresses strategic behaviour rather than being a response to structural market concerns which are generally understood to constitute "market failure");
- the fact that such measures are subject to very high standards of proof (because of the quasi-criminal characterization of such actions and the follow-on damages actions implications);
- the inability to deal with the granularity of mandated access (given that NCAs are disinclined to mandate behavioural remedies because of their inability to ensure their efficient implementation and, where necessary, modification or removal);[354] and
- the traditional reluctance of NCAs to act as price setting or price surveillance bodies (which is a task closely associated as a necessary accompaniment to any access remedy).

Aside from competition law remedies, in the absence of SMP regulation in WLA markets, it may also be possible for NRAs to mandate symmetric access obligations in the context of article 61 of the EU electronic communications Code. [355] Under these provisions:

352 Article 67, EU Electronic Communications Code

353 On average, an investigation under Article 102 TFEU takes up to three years and is usually appealed over a period of many years through the European court system. Thus, the respective margin squeezes cases before the European Commission involving Deutsche Telekom, Telefonica and Slovak Telekom respectively took nearly five years, nearly 1.5 years and just over four years. The constructive refusal to deal case brought against Telekomunikacja Polska took just over two years, while the predatory pricing action in Wanadoo took around 1.5 years. In each of these cases, the appeals to the General Court took 2-3 years, followed by a similar timeframe for appeals on questions of law to the Court of Justice. Even the reference from a Swedish Court to the Court of Justice for the purpose of establishing general principles of margin squeeze took over two years (followed by the time taken to apply that Judgment in practical terms in Sweden thereafter). NCA investigations are not significantly less cumbersome in terms of timing, except arguably for the French NCA, which has demonstrated a capacity to act quicker on average than its NCA counterparts in cases affecting the electronic communications sector.

354 Indeed, the residual powers of NRAs to subject disagreements between an access provider and access seekers to its own dispute resolution proceedings can be contrasted to the (far less satisfactory) outsourcing of that task to third party arbitrators under the terms of remedy packages proposed by investigated parties. Moreover, whereas an NRA has had to review the efficacy of its measures every three years (and now every five years under the EECC), remedies are prescribed for much longer periods by NCAs, whose procedures are quite lengthy where an order to review the measures is to be considered and either softened in its impact or extended in its duration because of changed circumstances.

- NRAs may, on reasonable request, impose obligations on providers of e-comms networks or the owners of relevant infrastructure (if not e-comms providers), for access to wiring and cables and associated facilities inside buildings or up to **the first concentration or distribution point as determined by the NRA**, where that point is located outside the building. The NRA must demonstrate that replication of these network elements would be economically inefficient or physically impracticable. Conditions that can be imposed include specific access obligations, as well as rules on transparency, non-discrimination and on apportioning the cost of access, where appropriate adjusted to take into account risk.
- NRAs may, where they conclude that the above obligations (as well as obligations resulting from any relevant market analysis) do not sufficiently address high and non-transitory economic or physical barriers to replication significantly limiting competitive outcomes for end-users, **extend symmetric access obligations "on fair and reasonable terms and conditions" beyond the concentration or distribution point**, to a point that it determines to be the closest to end-users capable of hosting a sufficient number of end-user connections to be commercial viable for efficient access seekers. In doing so, they must take utmost account of BEREC Guidelines to be developed on this subject.
- If justified on technical or economic grounds, **NRAs may impose active or virtual access obligations.**

Under normal circumstances (and in the event that the conditions warranting exemptions from these obligations are not met), it can be presumed that NRAs would consider that access to in-building wiring would be justified. However, in cases such as France and Spain, symmetric access at this level of the network (coupled with SMP PIA) has been proven insufficient to support effective competition in VHC broadband in areas outside those which are most densely populated. Consequently, in the absence of a presumption in favour of ex ante regulation (in non-competitive zones), NRAs may deem it necessary to extend regulation beyond the concentration or distribution point and/or impose active or virtual access obligations by means of symmetric regulation. Such an approach may be appropriate as an alternative to SMP regulation in certain circumstances (e.g. where VHC networks are in the process of being deployed, and will be deployed by multiple different parties in different areas).[356] However, this situation is atypical. Mandating remedies on all players may impact investment incentives in cases where VHC connectivity is being deployed by smaller players which were not subject to access regulation at the time when they developed their business plans.[357] Moreover, under the Code, symmetric remedies are intended to be imposed on request (rather than ex ante) and are specified in considerably less detail than those available under SMP regulation. Symmetric regulation is thus likely to be considerably less

355 See Article 61(3) EU EECC.

356 See discussion of the French case and relationship between symmetric and asymmetric regulation in WIK (2019h).

357 The impact of symmetric regulation on regional operators is discussed in the WIK (2019i).

effective than SMP regulation in addressing cases where one or more operators are in a position of market power.

5.2.6.2 Wholesale central access

High barriers to entry

Barriers to entry in the WCA market are likely to be less pronounced than those in the WLA market. This is because, in the presence of upstream regulation competition in WCA may stem not only from operators using their own duct and pole infrastructure e.g. the incumbent and cable operators and/or any utility providers, but also from operators making use of PIA and WLA (including unbundling and virtual local access) to deploy VHC networks and provide competing VHC services nationwide. As of 2018, approximately 80% of the access lines in Germany were accessible via unbundling (local access).[358] An even higher proportion of households (98.5% of premises) could be competitively served via a combination of infrastructure competition, physical or virtual unbundling in the UK.[359]

Alternative operators may use their own infrastructure alongside these upstream wholesale inputs to compete in the wholesale central access market (by providing bitstream) as well as offering resale services and competing in the retail market. Indeed, in countries such as Sweden, where wholesale local access is widely available both from the incumbent (on regulated terms) and in some areas on commercial terms from municipal providers, aggregators and intermediaries have emerged which combine the available wholesale offers to provide bitstream services to ISPs. Data provided by NRAs in the context of this study show that around 10% of lines based on alternative operators' own infrastructure were provided on a wholesale basis to third parties.

PIA and WLA, coupled with deployment by operators using their own ducts or other solutions for the deployment of infrastructure, could in some circumstances result in the retail broadband market being effectively competitive. It is notable in this context that, in addition to Romania and Bulgaria (where neither WLA nor WCA are considered to meet the three criteria test), Sweden has found that the WCA market is effectively competitive, and a large number of other NRAs have concluded that it is competitive across a significant proportion of the national territory.[360]

Amongst those which have not found that this market was effectively or prospectively competitive, a key reason may have been the relevance of cable access (which cannot viably be offered in a manner equivalent to VULA using current technologies). This is true at least

358 See WIK (2018d).
359 Ofcom 2018 market analysis https://circabc.europa.eu/sd/a/96f18e48-3ff4-44d5-9be5-8cfa18b89fb3/UK-2018-2094-2095-2096%20Adopted_EN.pdf
360 See market 3b status of competition at https://ec.europa.eu/digital-single-market/sites/digital-agenda/files/newsroom/art_7_march2020_57033.jpg

for Belgium, the Netherlands, and Denmark, but is not a phenomenon which is relevant across the majority of member states.

In certain other cases, with the migration to NGA, and associated challenges in maintaining physical unbundling, bitstream access on NGA has been mandated through the WCA market. However, if appropriately specified local Ethernet access products are developed, it is possible that the introduction of VULA in these countries via the WLA market may be sufficient to support downstream competition.

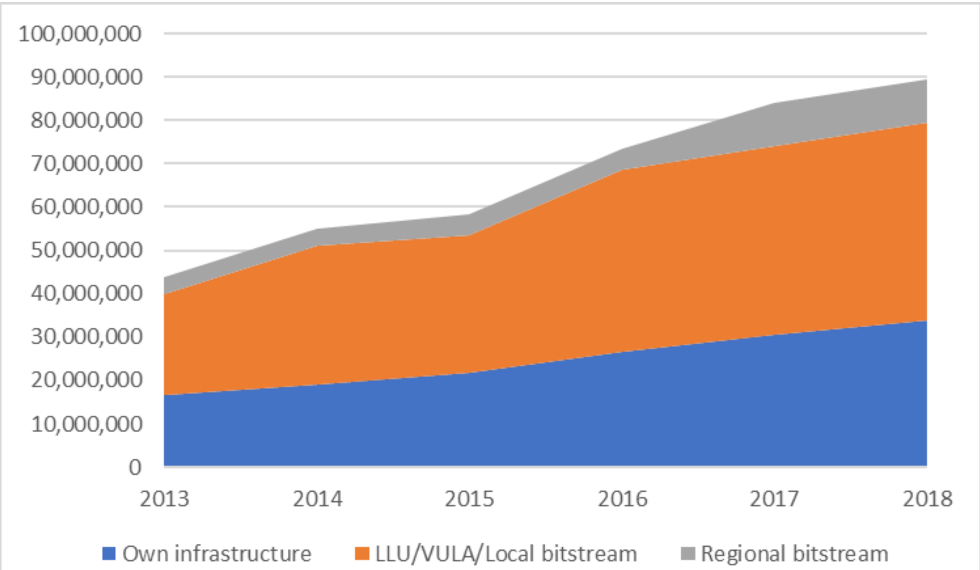
It is also possible that the effective regulation of backhaul, for example via the market for dedicated connectivity, could support more extensive use of WLA in areas where there has been reliance on bitstream access. This has for example been the experience in France and the UK.

Thus, we conclude that the WCA market does not exhibit high barriers to entry, for the majority of the territory across the EU. There may be some exceptions however in more remote regions.

Limited tendency to competition

Data provided by NRAs on the degree to which alternative operators have climbed the ladder of investment show a significant increase in competition based on own infrastructure and local access (based on SLU, LLU, VULA or local bitstream). As of 2018, regional bitstream accounted for around 10% of total lines provided by alternative operators.

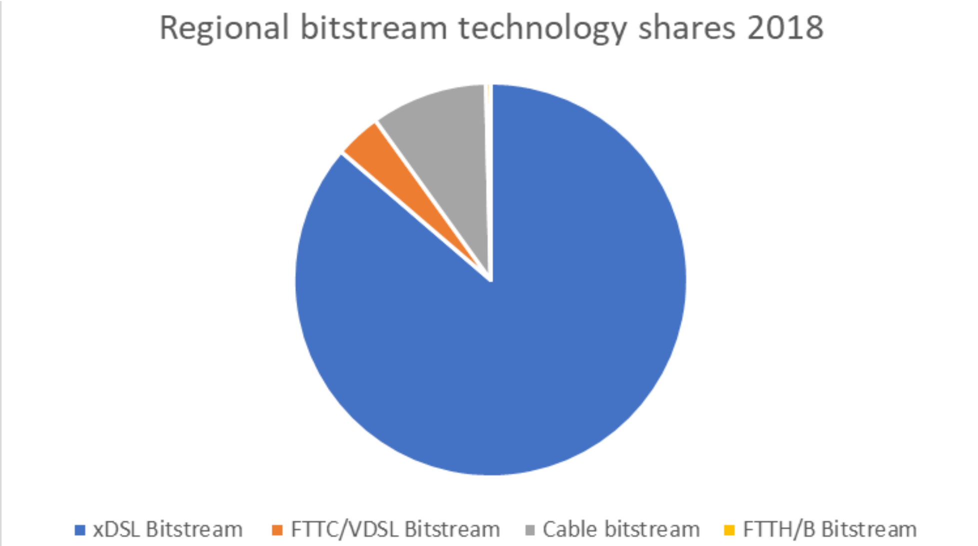
Figure 5-35: Number of alternative operator connections by degree of infrastructure (ladder of investment)



Source: WIK-Consult based on NRA Data Oct 2019

One area in which reliance on bitstream has persisted is on the copper network (see below). Such reliance may persist or even increase as the number of customers remaining on copper declines with the migration towards NGA and VHC networks, making physical copper unbundling unviable (and noting that some copper upgrade technologies also preclude the use of physical copper unbundling). In the absence of regulated access to copper bitstream, customers relying on the copper network (or for whom copper is the only network available e.g. in rural areas) may experience a decline in the choice of service provider.

Figure 5-36: Regional bitstream technology shares 2018



Source: WIK-Consult based on NRA Data Oct 2019

For as long as copper remains the only option for such customers, there is a case to maintain regulated access to bitstream in these cases.

However, commercial upgrades, as well as state aid programmes at national and EU level[361] are likely to reduce the reliance on copper in rural areas within the period of this Recommendation. In turn, connection points for FTTC/VDSL and FTTH-based infrastructure may aggregate a larger number of households than were possible via copper,[362] improving the economics of reaching rural communities via local wholesale access. Moreover, wireless technologies are starting to compete with or replace copper infrastructure in such areas (e.g. in Estonia, Sweden and Italy),[363] and further competitive options for VHC access via wireless infrastructure may develop with the deployment of 5G FWA. Since mobile operators

361 A summary of national state aid programmes and proposals for the implementation of the EU CEF2 programme are contained in Ecorys et al (2020). The Commission has proposed funding of €3bln to cover digital infrastructure via the new CEF programme.

362 For example, in the UK, VULA is available at a subset of exchanges (984 compared with 5,500 for copper LLU). See WIK (2018d, section 3.4).

363 Estonia plans to switch 10% of its copper connections to wireless in the context of copper switch-off. 42% of Sweden's copper exchanges have been closed in rural areas and replaced by wireless technologies. See WIK (2019b). Wireless technologies have been used for rural areas in the context of state aid programmes in Italy, Greece and elsewhere.

are obliged to serve a large majority of households in rural areas through coverage obligations contained in their licences, it should be possible for wireless infrastructure-based solutions to be made available by a wider range of operators than copper-based solutions (if there is sufficient support for such connectivity through the availability of dedicated access for backhaul).

Thus, we conclude that this market presents a tendency towards competition, and thus does not meet the 2nd criterion of the 3 criteria test.

<u>Alternative measures insufficient</u>

As this market does not meet the first two criteria of the three criteria test at EU level, material competition problems are considered unlikely to be present on a widespread basis, and thus the use of alternative measures including competition law, should not be necessary.

5.2.6.3 Dedicated connectivity for access and backhaul

<u>High barriers to entry</u>

The deployment of dedicated fibre connectivity for business use is associated with high costs (especially where FTTH is not available in the local area), but can also be associated with significant revenues, enabling a positive business case for alternative operators.

However, there are exceptions, which suggest that high entry barriers may remain in certain cases and regions.

Experience from around Europe suggests that infrastructure-based competition in dedicated fibre connectivity for business use has been achieved in city centres and business districts.[364] The prospects for effective competition in business-grade dedicated connectivity can be further improved in cases where duct and pole access is available, which is the case in France, Spain and Portugal.

However, the costs of deploying dedicated point to point fibre can be very high, especially in rural areas and other zones in which mass-market fibre connectivity has not been rolled out, and for certain customer types, including schools, hospitals and other „socio-economic drivers“ this can be a significant barrier to obtaining the required connectivity.[365]

As an infrastructure which supports multiple end-user services, the economics for the deployment of backhaul capacity for fixed and mobile should be better than that for isolated dedicated connections. This business case should be further improved through duct and pole

364 This is illustrated through the carve-out of such districts from regulation in the UK and Austria and the geographic segmentation of remedies in countries such as France

365 Case studies conducted by Ecorys and WIK in the context of the study for the implementation of CEF Digital show that point to point connections to isolated schools could cost as much as €10,000, hampering take-up in the absence of subsidies access, and the potential for network sharing or co-investment. However, NRAs such as Ofcom and TKK, which have considered this market segment have still found that certain areas would not be served with competitive backhaul connections in the absence of regulation, and similar conclusions are implied by the analyses supporting regulated dark fibre backhaul as an associated facility in countries such as France, Netherlands and Sweden. Moreover, duct and pole access is not available in all member states.

The increasing use of backhaul to support both fixed and mobile connectivity should support economies of scope.

However, cost estimations by WIK in the context of CEF Digital have found that there are some areas where it would not be viable at all to deploy dark fibre backhaul without subsidies, and thus only one connection could be supported with subsidies. Further areas are only marginally viable, and thus unlikely to support competitive supply. In these areas, 5G connectivity may be the only viable VHC solution for end-users, and thus access to any single backhaul connection available, may be vital in supporting competition.

We conclude that dedicated access connectivity may present high entry barriers in some area types and for some use cases, especially where mass-market FTTH is not deployed or is not viable. Dedicated backhaul may present high entry barriers for certain routes, and is important in supporting access for rural communities.

<u>Limited tendency to competition</u>

Dedicated fibre connections for access and backhaul are unlikely to be capable of being replicated by wireless technologies, and indeed will be increasingly essential for wireless technologies to be able to meet the requisite quality of service (see 2.5.2).

Suppliers of mass-market fibre may be well-placed to enter the market for the provision of dedicated fibre access. However, the geographic scope of infrastructure-based competition in mass-market VHC broadband is limited in most countries (see Table 3-2), and thus prospective entry is also likely to be limited to certain areas, as discussed in the context of the WLA market.

Commercial co-investment could widen the scope for delivery of dedicated fibre access. However, as discussed above, it is unlikely that such agreements would cover all parts of the territory. As incumbents are strongly placed in dedicated infrastructure outside more densely populated areas,[366] and can leverage this coverage to gain multi-site contracts[367] and obtain an advantage in the speed of provisioning of 5G and the quality of the broadband connection, they would also have limited incentive to engage in such deals.

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366 For example, in an analysis focused on dedicated infrastructure, including dark fibre, NRAs in Austria and the UK found a significant difference in the competitive situation within dense districts and outside.

367 See for example the higher market shares of Telefonica in provision of services to larger multi-site businesses.

Network sharing in the context of mobile infrastructure could improve the conditions for the deployment of backhaul. In cases where this occurs amongst several parties, it may lead to routes for backhaul being considered effectively competitive. However, if such sharing is opposed by competition authorities, or occurs between only two parties, it may put one or more mobile network operators at a competitive disadvantage in the deployment of 5G services in rural areas. Moreover, such agreements may exclude the potential for other players with an interest in dark fibre backhaul from participating in the market in including players intending to provide IOT services using their own spectrum, or specialised fixed broadband providers.

With the evolution of new services including connected automotive mobility, we expect increasing trends towards the deployment of fibre in roads. This could be deployed by players other than the traditional incumbent or alternative operators such as road operators and/or municipal networks. Sharing a single fibre in this case is important in improving the business case for deployment of 5G along highways,[368] and might (where SMP is found) require the imposition of regulation.

We conclude that the market segment for dedicated connectivity for access and backhaul is unlikely to tend towards competition in certain areas . However, competition in these areas is likely to be important to bridge the urban rural divide and support competition in the provision of 5G and IOT/M2M services.

<u>Competition law and other measures insufficient</u>

As noted in the discussion of the application of the 3 criteria test to the WLA market, there are difficulties inherent in formulating and enforcing wholesale access remedies via competition law, which tend to render this mechanism unsuitable for the ongoing enforcement of access obligations on SMP operators.

In the absence of SMP obligations, there is the potential that NRAs could make use of article 61 of the EU electronic communications Code to impose symmetric remedies requiring access to dedicated infrastructure. However, as discussed in the context of the WLA market, symmetric measures apply to all operators (with some exceptions), are based on dispute resolution, and are not well suited to enforcing detailed access obligations in markets where there is one or more operator with significant market power.

5.2.7 Relevance of geographic segmentation

Geographic segmentation has played a significant role in the context of the current list of relevant markets in market 3b and in the segmentation of NGA remedies in market 3a. Some countries have also segmented market 4. If, in the new Recommendation, or in specific

368 For a discussion of 5G CAM business models, see WIK (2019d).

countries, duct and pole access is treated as a separate market with downstream markets respectively for mass-market data and dedicated access and backhaul, we can expect a significant role for geographic market segmentation in both these downstream markets, especially as copper is retired and competition conditions for VHC and dedicated fibre business access and backhaul become the primary focus.

NRAs will need to determine in each case the relevant geographic unit and criteria for „prospective competition“, and should preferably do so in a manner that is consistent across the EU.

The Communication accompanying the 2018 SMP Guidelines[369] notes that a geographic market should consist of an area in which the conditions of competition are sufficiently homogeneous and which can be distinguished from other areas. NRAs should ensure that the units are small enough to avoid significant variations of competitive conditions, but big enough to avoid a burdensome micro-analysis. The boundaries should reflect the network structure of all relevant operators and have clear and stable boundaries over time.

As regards the criteria for segmentation, especially if NRAs are seeking to distinguish prospectively competitive zones from those which are non-competitive, it may be helpful to rely on some of the same criteria as could be used for a forward-looking SMP assessment.

The number of parallel infrastructures with capabilities sufficient to provide a competitive constraint to each other is a particularly relevant metric to assess actual and potential competition. In the context of mass-market data for example, this may include advanced upgraded copper networks such as G.fast alongside upgraded cable and FTTH networks. Meanwhile, for dedicated access and backhaul, data on dedicated fibre lines would be needed.

The electronic communications Code (article 22)[370] includes provisions which will require national authorities to conduct „mapping“ exercises to understand the location and number of networks in a given area, as well as encouraging national authorities to prepare forecasts of coverage. Forecasts should include information about planned deployments of very high capacity networks and significant upgrades or extensions of networks to at least 100Mbit/s download speeds.

Mapping data should ideally be granular and accurate at the address level. Thereafter, available information should enable NRAs to group together areas which have similar competitive characteristics.

It would be logical for data from the mapping process to be used to identify areas with 1, 2, 3 or more parallel infrastructures of a given type, as well as to provide indications of where infrastructure competition could be expected to develop on the basis of forecasts, noting that

369 European Commission (2018d, section 2.3)
370 European Parliament (2018).

these areas may not be contiguous. Mapping should also capture data on the availability of physical infrastructure (ducts and poles), as DPA is an important enabler of infrastructure-based competition.

Another question that needs to be addressed in the context of geographic markets are whether only end to end parallel networks should be considered when counting the number of infrastructures, or whether lines available through network swaps/co-investment should also be included. The coverage and/or overlap needed within the relevant area of each of the competing networks in the relevant area is another important factor for which criteria should be established.

Market shares have been used by a number of operators as an additional criterion to assess competitive differences and potential between different areas. A significant difference between the market share of the incumbent in „competitive zones“ vs other areas could provide one indicator of a geographic boundary. This can be stark in some cases, as urban areas may in some cases be able to support 4 parallel infrastructures (with duct access), while often in rural areas, only one can be viably supported, potentially with a contribution from state aid.

Another factor which could be relevant in understanding the degree to which a given area may support competitive retail outcomes in the absence of SMP regulation is the status of wholesale supply, and the degree to which wholesale access could be expected to be provided on reasonable terms and at a fair price in the event that SMP regulation was removed. The choice of parameters and potential data sources will also be influenced by the approach taken towards segmentation and particularly whether NRAs err on the side of forbearance or precautionary regulation. In Spain and Portugal, the NRAs initially opted not to apply any access regulation on fibre (in the case of Portugal) or bandwidths above 30Mbit/s in the Spain, but rather mandated duct and pole access as a means to promote infrastructure-based competition. When geographically segmented regulation was finally applied in Spain 7 years after the initial NGA market review, the NRA was able to rely on actual data about the number of parallel networks and commercial swap agreements in specific areas, as well as providing scope through its criteria (coverage) to incentivise further expansion of competitors in those areas.[371]

Conversely, in France, the NRA aimed to define geographic zones in advance of deployment. As fibre deployment was still in its infancy, ARCEP relied on announcements from operators as well as an analysis of factors affecting viability (such as the size of buildings and urban density), to predict the zones in which different forms of infrastructure

371 CNMC maintained forbearance in municipalities in which at least two (ultrafast) competitors to the incumbent had 20% coverage.

competition could develop. ARCEP subsequently adjusted the geographic zones to reflect actual developments in the market.[372]

A third approach, pursued in many countries in the context of WCA, has been to start with nationwide regulation, and deregulate only when there is evidence that access seekers have climbed the ladder of investment to local access and unbundling.

5.2.8 What patterns of VHC competition might emerge across Europe?

The starting point for any analysis of the market should normally be the situation at retail level, in the absence of regulation in wholesale product market under consideration, but in the presence of upstream regulation and non-SMP regulation. In the case of mass-market wholesale data, this means assessing the retail market in the scenario where SMP and BB CRD PIA and other regulation are applied, alongside symmetric regulation such as access to in-building wiring, but where there is no regulation of VHC networks.

When we look across Europe, at retail competition in VHC, different patterns emerge.

The effects of this approach in a market with effective SMP DPA can be seen in countries such as Spain and Portugal, which opted not to regulate VHC from the outset, but initially applied forbearance on a nationwide basis, which in the case of Spain lasted 7 years, and which persists in Portugal to this day.[373] In these countries, the outcome was the extensive use of DPA by alternative operators to deploy networks in dense areas, coupled with swap arrangements to extend network reach while minimizing additional investment requirements. The competitive zone in which there is expected to be a choice of 3+ VHC offers on a commercial basis is understood to cover 39% of households in Spain and up to 80% of households in Portugal (see Table 3-2). The relatively large scope of the competitive areas in these countries was supported by the fact that competitors had built a significant market share through unbundling and the vertically integrated market structure (and absence of regulation) provided incentives for the players to secure commercial agreements which entailed deploying in certain areas and swapping access.

End-to-end infrastructure-based competition in VHC networks has also developed within certain areas in some Eastern European countries which have achieved extensive fibre coverage. Data provided by NRAs in the context of this study suggests for example that around 30% of households in Latvia and Estonia have a choice of VHC provider based on own infrastructure. Wholesaling is not widely used in these countries. The area served by three infrastructures in Slovenia is however much less.

372 In 2011 ARCEP identified “less dense” pockets within the very dense areas which would be subject to more stringent access rules on FTTH terminating segments, and in 2014 reduced the overall footprint of the very dense‘ areas.

373 Further details are described in WIK (2019e).

Table 5-12: % households having a choice of VHC networks (excluding wholesale)

	1+	2+	3+
Slovenia	69%	30%	7%
Latvia	61%	48%	33%
Estonia	70%	50%	30%

Source: Data provided by NRAs Oct 2019

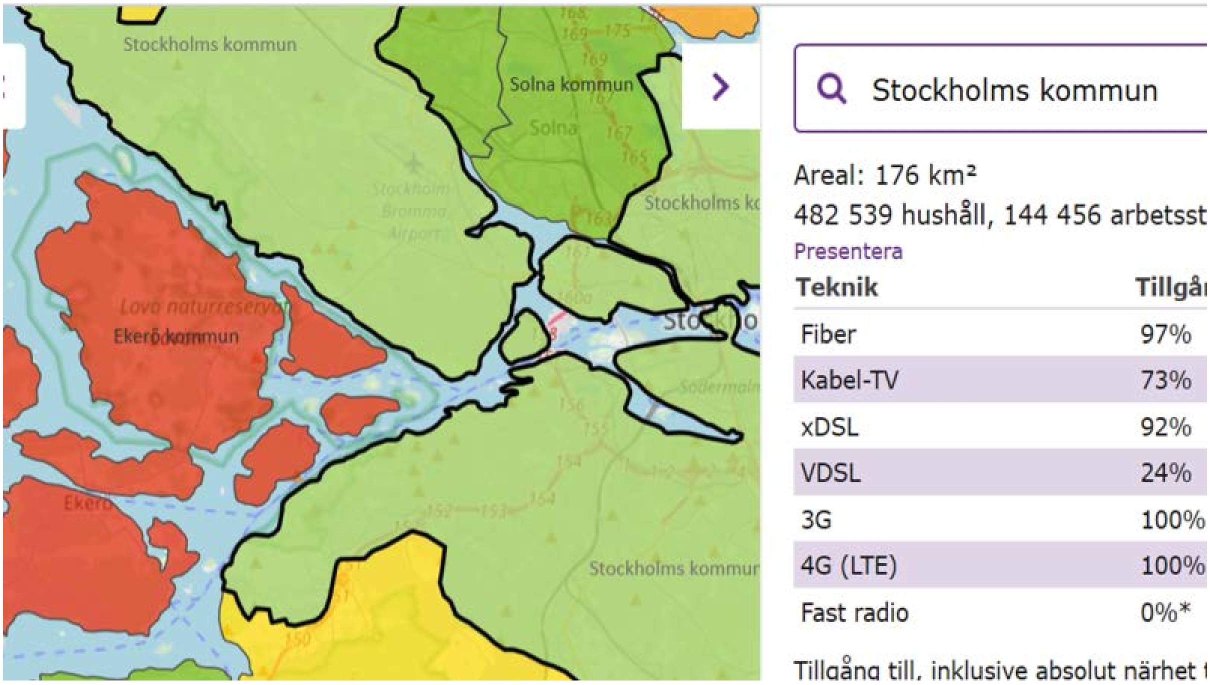
In countries such as Belgium, the Netherlands, Germany, Denmark and Sweden which lack effective DPA or which have not placed a significant focus on this remedy due to lack of demand or other factors, the degree of infrastructure competition based on 3 or more networks is significantly more limited than in Spain, Portugal, Latvia and Estonia.

However, alternative investors relying on their own utility infrastructure such as Wilhelm.Tel, EWE TEL (Germany) and Fluvius[374] (Flanders, Belgium) have deployed in certain areas. Utilities and municipal operators have built an even larger user base in Denmark and Sweden, benefiting from early deployment of FTTH.

Generally, the only areas in which three infrastructures are available in these countries is where the incumbent has deployed fibre and cable was previously present e.g. in Stockholm (see diagram below), some of the areas with City Carrier Presence in Germany such as Hamburg, and (limited) areas of new entry in Belgium and the Netherlands, which benefit from nearly universal cable coverage.

374 Glasvezel (2020b).

Figure 5-37: Coverage by technology in the Stockholm area



Source: PTS

Elsewhere in Sweden and Denmark and rural areas of Germany, the entry of fibre investors using or deploying their own duct infrastructure has resulted mainly in the presence of two infrastructures, including copper. Figures from the Danish Energy Authority (DEA) show for example, that when all copper is excluded (including FTTC/VDSL), no households were served by at least three network operators, and only 16% were served by two (fibre and cable).

Table 5-13: NGA and Gigabit capable infrastructure with 1, 2 or 3 network operators (% of households) in Denmark

	2015	2016	2017	2018
NGA infrastructure				
% HH served by at least 1 NGA-capable network (FTTC/VDSL and above)	91 %	87 %	90 %	92 %
% HH served by at least 2 NGA-capable networks (FTTC/VDSL and above)	38 %	37 %	39 %	43 %
% households served by at least 3 network operators	5 %	5 %	7 %	6 %
Gigabit infrastructure				
% HH served by at least 1 Gigabit capable network (FTTH and cable)	33 %	35 %	46 %	66 %
% HH served by at least 2 Gigabit capable network (FTTH and cable)	0 %	1 %	9 %	16 %
% households served by at least 3 network operators		1 %	0 %	0 %

Source: WIK based on DEA.

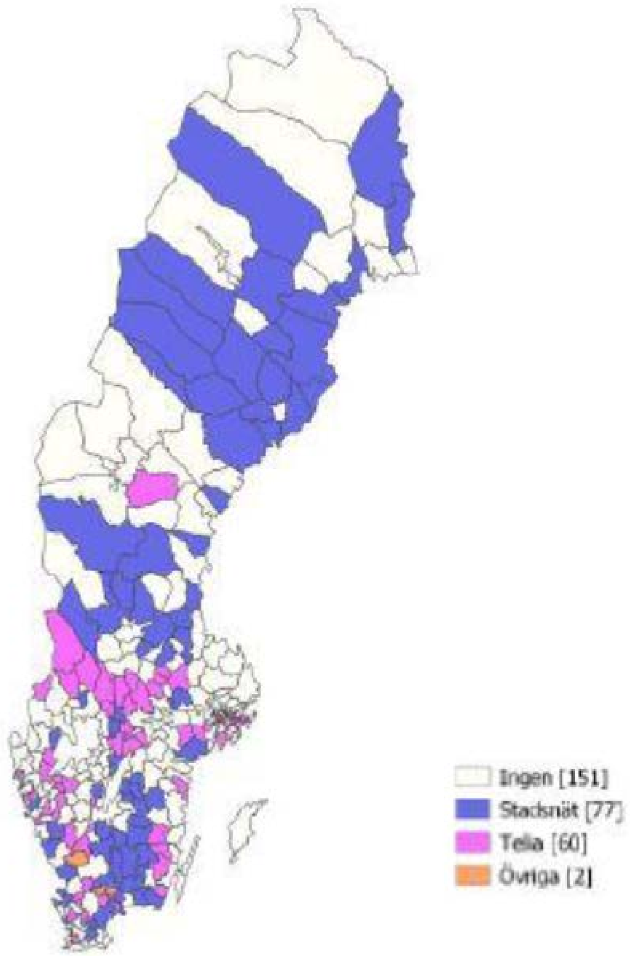
Note: NGA is here defined as infrastructure with a reported technologically possible max download capacity >= 30 Mbit/s. Gigabit-capable is here defined as coverage listed as being technically able to deliver at least 1 Gbit download. Currently, some fibre networks are only listed as being able to deliver speeds of less than 1 Gbit/s download and are therefore not included as Gigabit infrastructure in this table.

Telia's relatively limited fibre coverage (37% nationwide) and use of access from municipal networks, could also imply limited choice in Gigabit infrastructures (outside cable areas) in Sweden.[375]

Indeed, when the focus is placed on Gigabit infrastructures, beyond the cable area, a picture emerges of regional monopolies in many areas in Sweden, in which either the incumbent or municipal networks account for more 80% of connections at the wholesale level.

375 See Case SE/2019/2216.

Figure 5-38: Municipalities where a single network owner has more than 80% of connections at the wholesale level



Källa: PTS Byggnadsdatabas 2018.

The lack of additional retail "infrastructure" competition in these cases based on co-investment/swaps, may reflect the fact that regional and/or wholesale only operators have limited interest in this business model, as they do not offer retail services outside (or in some cases even within) their coverage area. Thus, the number of effective networks in each area can be expected to persist.

If these kinds of patterns are repeated across Europe, we could expect to see some countries with competition based on vertically integrated business models in which a portion of the country (up to 30-40%) might be served by three or more VHC networks based on own infrastructure and agreements (in cases where effective DPA is available and/or deployment costs are low), with a further portion having more limited or no competition in VHC networks. Meanwhile, in other countries, we may see a system of regional monopolies emerging in VHC connectivity, or duopolies in cases where cable is prevalent.

5.2.9 The perspectives of stakeholders

In the context of this study, WIK-consult conducted detailed interviews with 9 stakeholders focused on approaches towards geographic segmentation. Stakeholders were selected so as to represent different business models including incumbent operators such as Orange, Telia and Telefonica, alternative operators relying inter alia on co-investment and access such as Fastweb and Vodafone,[376] wholesale only fibre investors such as Stokab and Open Fiber, regional players such as those represented by the German trade association BREKO and business specialists such as BT Global.

Interviews were based on questionnaires circulated in advance and minutes were verified with the participating companies. Further feedback on geographic segmentation was received from stakeholders in the context of the March 2020 public workshop. This feedback is described in the Annex to this study. In summary:

- Most alternative operators, regional investors and cable operators consider that markets are generally national in scope, and that geographic market assessments should take this as a starting point. The prevalence of multi-site contracts was cited as a supporting argument for national markets in relation to business communications. However, incumbents generally consider that there is competition at a regional level and that geographic segmentation is appropriate
- Incumbent operators generally consider that the degree of constraints from copper is declining and that geographic segmentation would be highly relevant in the context of markets focused on VHC. Alternative operators, regional investors and cable operators on the other hand generally consider that the constraint from copper on VHC technologies will persist in the medium term, and thus that there is no case to consider market segmentation (at the level of the market definition) in the context of VHC.
- Some respondents highlighted the importance of ensuring that regional units chosen reflect homogenous market conditions. This may in some circumstances be met by analysing conditions at the level of the municipality, but not in all. One respondent suggested that differences in the potential for competition could better be indicated by whether a premise was a multi-dwelling unit or business (as opposed to single residential dwelling), rather than distinguishing geographic areas.
- Some incumbents and a cable operator noted that 2 infrastructure providers could be sufficient to support competition in certain circumstances. However, others considered that at least three would be necessary to consider that an area was competitively supplied and several respondents noted that assessments of differences in geographic conditions should not be based on the number of networks, but on a variety of criteria and should reflect the prevailing competitive conditions. While high and overlapping coverage by different operators the geographic unit was

376 Vodafone also operates an extensive cable network in Germany and Spain.

considered necessary to reflect competitive constraint by alternative operators and competitive investors, incumbents considered that lower coverage levels could be appropriate and provide the right signals to promote further infrastructure deployment.

- Alternative operators and some regional investors considered that retail broadband market shares were an important consideration in determining whether an area could be prospectively competitive. Market shares could indicate whether alternative operators had sufficient scale to invest in their own infrastructure or shift their customer-base to an alternative infrastructure provider.
- Alternative operators highlighted the importance of assessing in the areas considered to be prospectively competitive, whether wholesale offers would be available for both residential and business use.

5.2.10 Appropriate principles for geographic analysis at EU level

5.2.10.1 Actual or theoretical analysis

Before an analysis is conducted, NRAs need to consider on what basis they will conduct the analysis. A particularly relevant question is whether they will based the assessment on the actual state of the market with scope for further development, or whether they will rely in part or wholly on theoretical considerations.

The approach taken by NRAs in Spain and Portugal to VHC regulation was based on forbearance with later evaluation of the competitive effects of DPA and symmetric access to in-building wiring. This enabled the assessment to be conducted on the basis of actual data about deployment and announced plans. Another approach taken by some NRAs pursuing infrastructure competition via DPA is to predict the degree to which competition is considered likely to develop, and establish prospectively competitive and non-competitive zones on that basis, applying regulation in the non-competitive zones from the outset. A prime example of this approach is France, which in the context of applying symmetric regulation, distinguished between “very dense” and “less dense” areas as a means of distinguishing regulation prior to the widespread deployment of VHC infrastructure.[377]

There are pros and cons to each of these approaches. Whereas a forbearance first approach risks (temporarily) undermining competition in VHC in areas where (co-)investment does not materialise, it may maximise incentives for alternative operators to invest and engage in commercial access arrangements. Conversely, the predictive approach such as that taken in France provides greater protection for consumers in less dense areas, but risks limiting the zone of commercial (co-)investment, in the event that predictions are inaccurate. An approach to regulate on a national basis from the outset, and segment only when competitive differences arise tilts even further in this direction.

377 These cases are described in detail in WIK (2019e).

Clearly, **in countries where competitive deployments in VHC are advanced a geographic analysis can be conducted on the basis of actual data and potentially known plans by the operators concerned, while also taking a forward-looking perspective. NRAs analysing markets prior to the widespread deployment of VHC (and particularly FTTH) networks, must on the other hand make a choice between an analysis based on actual data or theoretical assessments.** When choosing which approach to follow, it may be helpful to assess the likelihood that alternative operators can in practice deploy their own infrastructure or engage in co-deployment. This is likely to depend on the effectiveness of PIA in the relevant areas and/or reasonable expectation that utilities or municipalities could enter the market. A high retail broadband market share for prospective alternative investors in such areas is also an important consideration, as this market share (even if it is currently based to a large extend on basic broadband via unbundling) can be transferred on a newly deployed network, considerably reducing the investment risk.

The choice of approach will affect the available data, and whether geographic assessments are based on actual data or theoretical considerations based on the viability of competition.

5.2.10.2 Retail analysis on the basis of the modified greenfield approach

In line with the 2018 SMP Guidelines, NRAs should start by considering whether different players are active in different areas or if there are variations in the competitive conditions for broadband (or in time VHC) at the retail level, that would result in different competitive conditions for end-users (such as greater degrees of choice and innovation, lower prices for a given quality) in the absence of VHC access regulation.

A challenge in this assessment is to discount the effect that competition based on VHC SMP regulation may be having in smoothing competition and consumer outcomes in terms of choice and price, and potentially quality in different areas. Thus, while they should be examined, retail market shares may not give a precise indication of competitive conditions in the presence of VHC regulation.

However, NRAs may be able to gauge whether there are different actors or conditions in different regions by identifying whether there are areas which have (or which could support) a greater degree of infrastructure-based competition than is typical e.g. three or more networks, and by assessing whether there are significant differences between the wholesale market share of the incumbent (including self-supply) in different regions. The presence of a different number or range of service providers, and VHC offers (and pricing) which are specific to given areas, could be another indicator of differentiated conditions.

When they identify areas with clearly different competitive conditions at retail level (e.g. in terms of the number or nature of service providers, price and quality of offers), NRAs should seek to understand what the main drivers of these differences are. For example, are these areas characterized by a greater degree of infrastructure competition, or by the presence of operators with different business models such as wholesale only.

Where a distinction is found at retail level, the apparent drivers behind the distinctions should be noted and a more thorough investigation should be conducted with a view to potentially identifying different geographic markets at wholesale level.

5.2.10.3 Wholesale geographic analysis

When conducting a geographic analysis at the wholesale level, NRAs will need to establish clear principles and gather and interpret data on this basis. Some principles that could apply at EU level are discussed below.

Appropriate geographic units and aggregation

Choosing the right geographic unit, is important in enabling distinctions to be made between zones which are prospectively competitive, and those which might require regulation.

Postcodes and municipalities have been the typical metrics used to assess geographic variations in VHC competition. However, MDF sites have also been used e.g. in the case of Spain, as they reflect the point of presence of alternative (unbundling) operators.

In practice, experience suggests that for a potential „wholesale mass-market data" market, geographic units should, be based around areas which map to the presence of existing networks (e.g. where cable or municipal networks are located), are based on units which would be used by new investors to make decisions about the scope of their deployment and/or (especially where a theoretical analysis is conducted) be of a particular density and/or type e.g. urban, suburban etc. that may reflect the differing economics of network deployment across a country.

For the supply of dedicated capacity, in markets in which there is no widespread deployment of FTTH, data on the proximity of existing dedicated connections to business premises may be appropriate, as this may reflect the capability of operators to provide a connectivity offer. Post code level data could also be used for a market for dedicated access, or if wider areas are required, areas could be defined with reference to business, mobile base stations or "socio-economic driver" density and/or the presence of alternative networks in the supply of dedicated capacity that may indicate greater levels of competition. The distinction between relevant zones for mass-market and business might become blurred over time with the deployment of mass-market FTTH by operators that are capable of deploying dedicated connections.

For inter-exchange backhaul, routes may be an appropriate unit.

For the identification of zones with different characteristics, aggregation of the areas should be based on criteria which allow a distinction to be made between zones in which one operator has SMP (which could be different operators in different areas), vs those in which there may be joint SMP vs those in which no operator has SMP. This is in line with competition law principles, which imply that markets should be distinguished so as to identify areas in which the conditions of competition are similar and which can be distinguished from neighbouring areas in which the conditions of competition are different.[378] Any subsequent SMP designation could then separately identify SMP operators, if different operators have SMP in different areas.

Criteria for segmentation

In the staff working document accompanying the 2018 SMP Guidelines, the European Commission points out that a geographical segmentation of markets based solely on the number of operators present in a given geographic unit (for example a local exchange area) is not by itself sufficiently detailed or robust to identify real differences in competitive conditions for the purposes of market definition.

Rather, the application of cumulative criteria to aggregate geographical units with similar competitive conditions based on an analysis of demand and, more importantly (in the context of a competitive analysis) supply-side, conditions is required in line with the SMP guidelines.

The main supply-side conditions examined by NRAs have been the number of operators, their coverage and the market share of the incumbent. The type of operators and provision of wholesaling were also identified as important factors in the context of interviews conducted for this study. The chosen criteria could be sufficient to assess whether a given aggregation of areas is likely to be subject to single SMP or effective competition. Further analysis, reflecting the guidance on this subject provided in the 2018 SMP Guidelines, is likely to be needed in the context of zones which might potentially be subject to joint SMP.

As regards numbers, NRAs have typically considered that 3 parallel infrastructures (incumbent + two others) should be sufficient to support competition in a given area. However, it is important not to rely only on the numbers of infrastructures present, but to provide evidence that, in the context of the country concerned, that number is associated with differences in consumer outcomes (from the retail analysis). Three operators may be sufficient in some circumstances, but may not be sufficient, if high entry barriers remain (see discussion on wholesaling). Equally, two may be sufficient, if there is evidence from the retail analysis that in the presence of two operators (when regulated access is discounted), wholesaling is available on reasonable terms and there is competition in price and quality at the retail level. Alternatively, two may be insufficient if competitive outcomes, including the commercial availability of wholesaling and competition in price and quality at the retail level do not differ significantly from cases where only one network is present. It is notable in this context, that in the context of basic broadband, NRAs did not find that the presence of cable operators resulted in a sufficiently significant difference that their zones of operation should

378 2014 European Commission Relevant Market Recommendation explanatory memorandum be subject to a separate market assessment. As a general rule, the distinctions made between areas (including any reflections on the impact of the numbers of operators present) should be focused on whether the distinctions are sufficient to warrant different conclusions as regards SMP.

As regards which operators are considered to provide separate networks, for the purposes of assessing the degree of competition in for example markets for WLA or dedicated access, it is not essential for the infrastructure to be duplicated end to end.[379] However, it is important to demonstrate that the operators concerned can act independently from one another, not only on pricing, but also in the context of quality and innovation. This is a relevant consideration, not only in ex ante regulation, but also in assessments of merger proceedings and the design of remedies to protect competition in the event of mergers. Co-investment or swap arrangements which involve passive (physical) access to infrastructure and long-term commitment on the basis of indefeasible rights of use (IRU), are more likely to meet these conditions than agreements which are based on active access and which involve a high degree of variable pricing.

The fact that an operator operates on a wholesale only basis does not necessarily mean that competitive conditions in its area of operation can be assumed to be different from those in which there are two vertically integrated VHC operators, or indeed where the incumbent is the only operator present. NRAs should assess at the retail level whether the presence of operators utilising such business models has a material impact on competitive outcomes for consumers, and take it into account only if positive effects are demonstrated. In this context, it is also important to note that there are different business models even within the definition of “wholesale only” (e.g. passive only vs passive and active), and effects should be judged case by case. Specific provisions have in any event been made under the EECC to apply lighter touch remedies to wholesale only operators found to have SMP.[380]

While three or more networks might be suggestive of (while not proof of) competition, the presence of one network is indicative of SMP, unless barriers to entry are low. In areas where no VHC or dedicated networks have been deployed, an operator may still be considered to have SMP, where it has plans to deploy or has the greatest opportunity to deploy such a network e.g. in view of the proxity of its physical infrastructure to the new area to be served.[381] When considering remedies in areas where VHC networks have yet been deployed, NRAs should take particular account of the need to provide appropriate incentives for new investments by the SMP operator,[382] and compensate costs in the case of dedicated lines which are built to order.

379 Consideration of competitive conditions in markets downstream from WLA or dedicated access would also take into account operators offering services on the basis of upstream regulated inputs.
380 See European Parliament (2018, article 80).
381 For example the Irish NRA Comreg designated the incumbent as SMP in areas where no dedicated leased lines have been deployed, due to its capabilities to deploy infrastructure in such areas.
382 The Portuguese NRA’s decision not to apply SMP regulation on VHC was partly based on a desire to incentivise investment in areas where such networks had not already been deployed.

NRAs have set different conditions as regards coverage considered sufficient to apply competitive constraints within a geographic zone. These range from coverage of 20% to 60% or more. While some NRAs such as AGCOM have also specified conditions around “overlap” of coverage, others such as CNMC have not. In practice, feedback from interviews[383] suggests that conditions may vary, and that the appropriate coverage level may depend on the degree to which entrants can be expected to expand within the area under consideration. If barriers to entry are low due for example to the presence of effective PIA, and operators are still in the process of expanding, a relatively low threshold may be suitable, based on the concept of “prospective competition” and the need to promote the required investment. On the other hand, if the prospect of further expansion is limited, a high threshold may be more appropriate together with an assessment of the degree of overlap. It is also relevant for the NRA to assess whether operators have in practice or have the scope to differentiate prices within the area under consideration, for example to higher prices for customers which do not have a competitive choice, and lower prices elsewhere. In areas of prospective competition, predation may be a more important consideration than excessive pricing. NRAs should also therefore consider whether, in the absence of regulatory controls, existing operators would have the ability to deter further investments or undermine existing investments. This may be suggestive of market power, potentially requiring regulation to prevent “eviction”.

Market shares

Most NRAs conducting geographic analyses have used incumbent market shares of 40-50% as one of the criteria for determining whether an area is competitively supplied. Market shares have not however been taken into account in all cases. For example, Ofcom considers market shares in the dedicated access market in the context of the market analysis rather than in the process of defining geographic markets. More generally, defining markets in the context of a 5 year prospective analysis, will require particular attention to the potential for competition (e.g. in view of the economics of replication), rather than sole reliance on historic trends in market shares.

In cases where potential competition may come from alternative operators climbing the ladder of investment, broadband retail market shares may be relevant in assessing the degree to which there may be a business case for such competitive investment in VHC, noting that alternative operators would likely migrate their existing customer base from LLU and/or VULA as a key element of the business case. Market shares of entrants are also relevant to understand whether a new entrant wholesale only provider may have a sufficient source of potential wholesale customers to support its business case. Current practice of using 40-50% market share of the incumbent as a benchmark is consistent with competition law guidelines and cases concerning the presumption of dominance.

Wholesale market shares (including self-supply) may be relevant in understanding the degree of threat from infrastructure competition posed to the incumbent in different areas. It

383 For example, feedback from Orange, Vodafone, Open Fiber.

may also serve to identify different regional monopolists in a VHC-focused environment. **40-50% market share of the incumbent could provide a useful benchmark.**

Wholesaling

The presence and strength of commercial wholesaling has not been widely used as an indicator for prospective competition. However, the provision of wholesale offers on fair commercial terms could be considered to be an indicator of an effectively functioning market, in which infrastructure providers seek to expand their customer base to address competitive threats from their infrastructure-based rivals.

Given high barriers to entry, the availability of wholesale services on a nationwide basis is also crucial to enable nationwide competition for a new entrant in the mass-market, and to enable a business service provider to complete for multi-site contracts.

The prospect of continued availability of wholesale offers for residential and business customers on fair terms and conditions following any deregulation of VHC (or dedicated capacity) should be considered as a factor affecting whether the competitive conditions in a given geographic area are sufficiently different to warrant a no SMP finding.

5.2.10.4 Conclusions

In conclusion, as regards geographic segmentation we advise that:

- NRAs should first assess whether there are any variations in competition at the retail level, following the modified greenfield approach (i.e. in the absence of VHC or dedicated access regulation). Variations could take the form of different main suppliers, different numbers of infrastructure-based suppliers, differences in retail competition (e.g. number or nature of ISPs), quality and prices available, or stark differences in wholesale market shares (including self-supply). The drivers of different consumer outcomes such as choice, price and quality should be noted as these may be relevant for the wholesale criteria and analysis. If competitive differences are found at the retail level, a detailed geographic analysis should be conducted at the wholesale level.

- A wholesale analysis based on actual data and prospective deployment will be relevant in countries where VHC deployment is advanced. A theoretical analysis based on the business case for and likelihood of deployment may be appropriate in countries where VHC is less advanced.

- The geographic units chosen should, as far as possible, enable a reflection of the scope of coverage of existing infrastructure-based competitors e.g. cable or municipal and the relevant areas for investment decision-making for potential new entrants. Where FTTH is not widely deployed, the considerations for dedicated access may be different e.g. distance of networks from customers. However, the indicators for geographic segmentation may merge when FTTH has been widely deployed. Route-based segmentation is approach for exchange to exchange backhaul. Areas should be aggregated into zones which exhibit differences in the SMP status.

- Numbers of networks are relevant, but not definitive, as NRAs should primarily be guided by distinctions in market conditions which result in different conclusions in different areas regarding SMP. Three networks may be indicative of competition, but may not be enough if there is no fair commercial wholesale supply. One is indicative of SMP unless there are low entry barriers. Two is not normally sufficient, but wholesale availability and differences in retail conditions should be assessed, and some adjustments could be made to remedies rather than in the context of the market definition, where appropriate. Networks should be counted if they are independently operated. This is likely within a co-investment in the presence of physical access and IRU. The fact that a network is wholesale only does not necessarily imply that two networks is sufficient – the impact of the business model of such a kind of player would need to be assessed at the retail level. Coverage requirements per operator should take into account the potential for expansion e.g. early period in deployment, presence of PIA. Higher coverage and overlap requirement would likely be needed where there is limited prospect of expansion

- Market shares should be considered as an indicator of the potential business case for a wholesale only investor or for an existing operator to (co-) invest. 40-50% shares for the incumbent are a relevant threshold; and

- The prospect of wholesaling on fair and reasonable terms for the mass-market and high-end business supply in the absence of regulation, should be taken into account.

6 Fixed and mobile voice

6.1 Retail markets

6.1.1 The relevant 'voice' markets

The definition of 'relevant markets' is time and country specific. Competition law market definition is a tool to identify and define the boundaries of competition between firms. The objective of defining a market in both its product and geographic dimension is to identify those actual competitors of the undertakings involved that are capable of constraining those undertakings' behaviour and of preventing them from behaving independently of effective competitive pressure.

Under Article 16 of Directive 2002/21/EC ("the Framework Directive"), only markets susceptible to ex ante regulation have to be identified: i.e. market where were there would be a risk of consumer harm due to a lack of competition absent regulatory intervention in the relevant market or upstream.

The 2003 markets recommendation[384]: listed seven retail markets:

1. Access to the public telephone network at a fixed location for residential customers.
2. Access to the public telephone network at a fixed location for non-residential customers.
3. Publicly available local and/or national telephone services provided at a fixed location for residential customers.
4. Publicly available international telephone services provided at a fixed location for residential customers.
5. Publicly available local and/or national telephone services provided at a fixed location for non-residential customers.
6. Publicly available international telephone services provided at a fixed location for non-residential customers.
7. The minimum set of leased lines.

The 2007 Recommendation identified two different retail markets: (i) retail access to the public telephone network at a fixed location[385] and (ii) retail calls markets at a fixed location. Only the first was considered susceptible to ex ante regulation. The market included managed voice-over-broadband (VoB) services in countries where there was sufficient penetration and where respective substitutability existed.

384 European Commission (2003).

385 The 2003 recommendation distinguished between a market for access to the public telephone network at a fixed location for residential customers and a market for access to the public telephone network at a fixed location for non-residential customers.

The Commission no longer included the retail market for access to the public telephone network at a fixed location for residential and non-residential customers in its 2014 market recommendation. The reason was that "alternative operators without their own fixed infrastructure can relatively easily enter the market by way of making use of regulated wholesale inputs, namely LLU and bitstream. An alternative operator who seeks access to LLU or bitstream for the purpose of providing retail broadband services can relatively easily expand its offer to telephone services (both access and calls) by utilizing IP technology" and that "(i)n conclusion, the market for fixed narrowband access is no longer characterised by high and non-transitory entry barriers on a Union level."[386] Moreover, in view "of the price convergence between fixed and mobile telephony (also due to the stricter regulation of mobile termination rates), and the fact that access and calls are often purchased together, it can be expected that any potential SMP operator on the fixed access market will be constrained by mobile operators, either directly (if mobile and fixed services would be included in the same market) or indirectly via the SMP assessment"[387]. However, NRA's were not precluded to continue regulating markets which were longer included in the 2014 Recommendation, subject to the application of the three criteria test in order to assess whether on the basis of national circumstances that market would still be susceptible to ex ante regulation.

6.1.2 The NRA practice

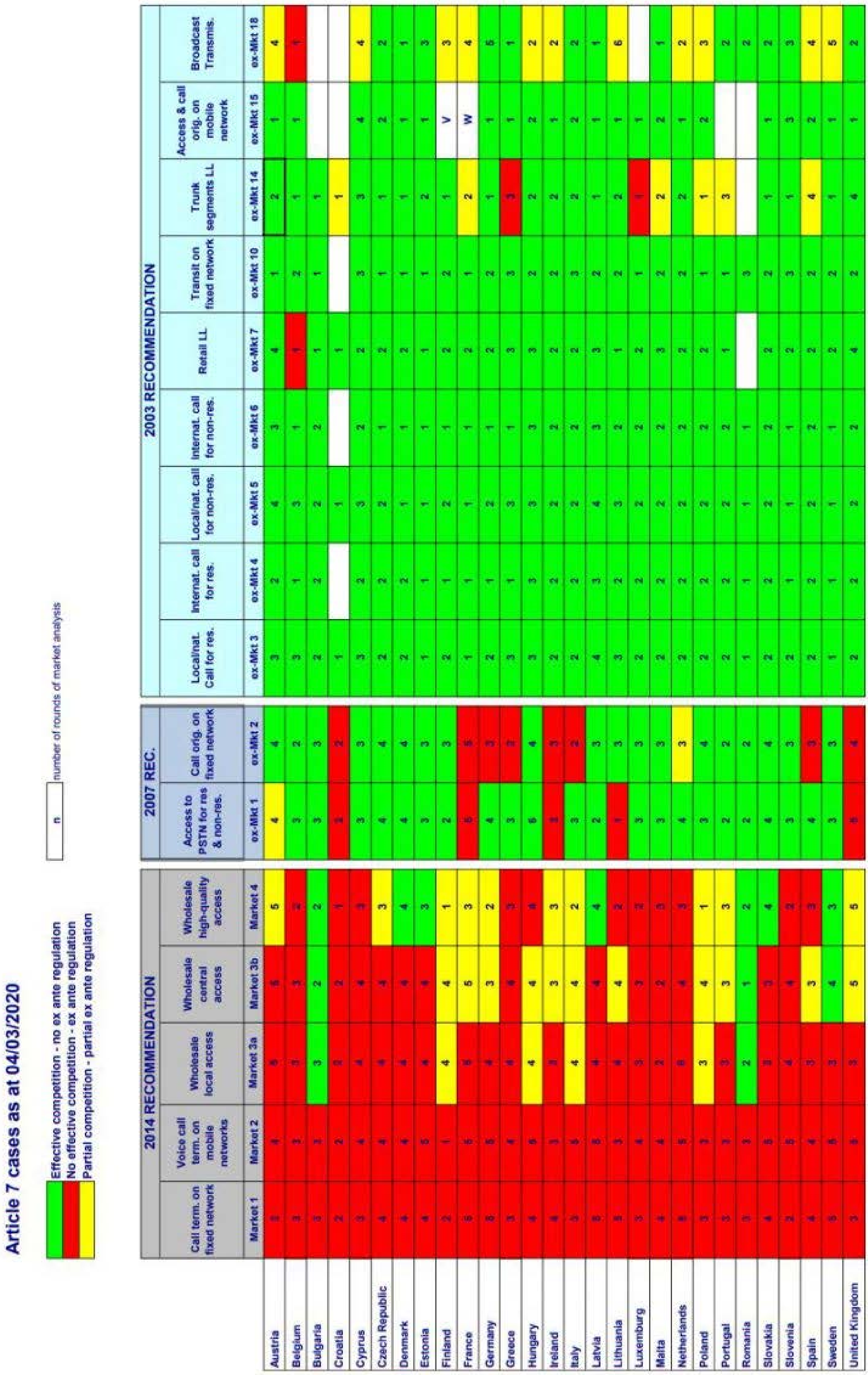
<u>The three criteria test</u>

Since the enactment of the 2014 markets recommendation, the NRAs of 21 of the Member States considered that there was no justification to continue regulating the retail market for access to the public telephone network at a fixed location for residential and non-residential customers (market 1/2007). Their decision did however not mean the absence of competition concerns, but rather, as the Commission anticipated in the explanatory memorandum to the markets recommendation, that regulation at wholesale level was sufficient to address the possible competition concerns. Under the 2018 SMP guidelines, a retail market should only be subject to *ex-ante* regulation where relevant wholesale measures fail to ensure effective competition: a "downstream market should only be subject to ex ante regulation if competition on that market still exhibits significant market power despite the presence of ex ante regulation on the related wholesale upstream market(s)."[388]

However, the NRAs of six Member States[389] found that the three criteria test justified the continued regulation in the light of national circumstances.

386 CNECT (2014, p.23).
387 CNECT (2014, p.24).
388 European Commission (2014a, recital 18).
389 Austria, Croatia, France, Germany, Lithuania and the UK.

Figure 6-1: Article 7 cases – situation in March 2020.



Member States still regulating retail voice markets

Austria continues to regulate the sub-market for access to the public telephone network at a fixed location for non-residential customers (market 1/2007) via analogue or digital access telephone networks realised by means of copper pairs, optical fibre network, unbundled local loop or cable network access. Such access covers local fixed connections and the possibility to receive calls. VoB is considered as part of the relevant market. Access through mobile networks with a fixed network termination point is part of the market, while mobile access and fixed connections which form part of a bundle product with a broadband connection are excluded from the market.[390] In that segment, the NRA still finds high and significant barriers to entry, mainly due to economies of scale and sunk costs. New market entries cannot be expected in the next regulatory period. Moreover, as regards the tendency towards effective competition TKK observes, in particular, that in this segment of the market A1 still held a very high market share[391] and has a significant independence in its price setting behaviour.[392] Consequently, the NRA maintained both a price cap and accounting separation imposed on the incumbent operator. The Commission acknowledged that there are users who cannot easily switch to another service/network because of the specific features of the PSTN-technology. However, the Commission had reservations against designing remedies for small, declining submarkets which contain only the most captive users. Such approach does, according to the Commission, “inevitably lead to market characteristics which suggest the existence of high entry barriers and SMP”.[393] Moreover the “consequent tight retail price control is likely to (…) discourage further market entry leading to perpetual regulation.”[394] The Commission therefore asked the NRA to “closely monitor the markets developments on the POTS and ISDN basic access markets for non-residential users taking account of the above said, with a view to deregulate the market, if appropriate, even before the end of the three-year regulatory period”, i.e. end 2020.[395]

Croatia also continues to regulate the retail market for access to the public telephone network at a fixed location.[396] The NRA defined the relevant product market to include access by means of IP, analogue (POTS), ISDN, CaTV and fixed wireless connections but to exclude mobile telephone networks (which the NRA considered as a complementary product rather than as a substitute to access at a fixed location). On that market, the incumbent operator and its affiliated companies are found to have SMP. Remedies consists in an obligation to provide wholesale line rental (WLR) on PSTN and VoIP, a price control on WLR provided stand-alone, i.e. not bundled with bitstream access (retail minus 15%), non-discrimination, accounting separation and the requirement that pricing does not lead to a

390 Case AT/2017/1971, p.4.
391 In this segment of the market A1 held a 86.4% market share in terms of connections
392 In the segment of ISDN basic connections, the cheapest A1 tariff is about 25% more expensive than the lowest tariff of all identified alternative providers. Nevertheless, in the years from 2013 to 2015, there were no tariff adjustments by A1.
393 Case AT/2017/1971, p.9.
394 Case AT/2017/1971, idem.
395 Case AT/2017/1971, idem.
396 See Commission decision of 12.3.2018 in case HR/2018/2059, C(2018) 1591.

margin-squeeze. In Lithuania, the incumbent was found to have SMP on both the market for access to the public telephone network at a fixed location for residential and the market for access to the public telephone network at a fixed location for non-residential customers.[397] Both markets comprise access provided via PSTN, ISDN and managed VoIP technologies through inter alia metallic twisted pair lines, coaxial cable lines, fibre optic lines, UTP lines and wireless cable lines. The incumbent held 96.9 % of the market for residential customers and 83.2% of the market for non-residential customers (in terms of number of lines). Significant entry was not expected because the retail access markets' tendency to shrink making these markets no longer attractive for investments. The NRA imposed the following remedies: (i) carrier selection and pre-selection ("CS/CPS") to ensure that the customer can select the public telephone communication service provider; (ii) accounting separation and (iii) wholesale line rental ("WLR").[398] In order to ensure the effectiveness of the WLR remedy, associated obligations of non-discrimination, price control and cost accounting were also imposed on the incumbent. In France, the NRA continues to regulate the retail market for fixed telephony access for the non-residential users.[399] The NRA notes that some 75% of business users' telephone lines are still based on PSTN and that business users consider such connections more secure and allow them to use their PSTN-compatible equipment (fax machines, PABX). The incumbent must continue providing a bundle including WLR with call origination, enabling ANOs to propose global telephony service offers over PSTN ("VGAST" offer proposed by Orange). This obligation is complemented with obligations of non-discrimination, transparency, including publication of a reference offer and of key performance indicators, quality requirements in the form of service level guarantees, accounting separation and a price cap. While the French, Croatian and Lithuanian NRAs impose WLR as a remedy to SMP on the retail market, other NRAs imposing WLR do so to remedy SMP findings in wholesale markets[400].

In Ireland, the incumbent continues to be regulated on a segment of the retail access to the public telephone network at a fixed location, the market for Standalone Lower Level Voice Access (LLVA) comprising PSTN, ISDN BRA or similar connection (cable, fibre, fix wireless access and DSL) that is used to provide voice service sold on a standalone basis or in a package with fixed voice calls.[401] The NRA considers that absent such retail regulation, the incumbent would have the incentive to increase its prices. The aim of the remedy is, on the one hand, to protect consumers who purchase standalone fixed access and do not value broadband (or other bundles) to such an extent that they would be willing to switch to bundles and, on the other hand, to prevent the incumbent to increase its line-rental tariffs in order to increase its WLR tariffs, set on the basis of a retail-minus methodology, and hence, limiting the impact of its competitors at the retail level. In Cyprus also, the NRA maintains retail regulation only regarding part of the access to the public telephone network provided by

397 Commission decision of 29.7.2015 in case LT/2015/1762, C(2015) 5494.
398 It appears from the Commission decision that WLR was only used for non-residential customers and that the usage grew from 6 lines in 2013 to 363 lines in June 2015 (case LT/2015/1762, o.c., p.4)
399 ARCEP (2017b). See also Commission decision of 14.12.2017 in case FR/2017/2038, C(2017) 8890.
400 Market 3a/2014 (Italy and Greece), market 2/2007 (Netherlands, Spain and Ireland) and in the UK, the market for wholesale fixed analogue exchange line services (WFAEL).
401 Commission decision of 28.7.2014 in case IE/2014/1629, C(2014) 5482.

the incumbent: to access provided via a PSTN interface. On this market, the remedies imposed on the incumbent include obligations of CS/CPS, WLR, transparency, non-discrimination, price control, prohibition of unreasonable bundling and accounting separation. Conversely, retail access via ISDN BRA 2B+D and ISDN PRA 30B+D was deregulated.[402]

Germany is the sixth Member State in which the NRA continues to regulate the retail market for access to the public telephone network at a fixed location for residential and non-residential customers. The relevant product market includes narrowband access products such as analogue, ISDN basic and primary rate multiplex lines (PMx), stationary wireless narrowband solutions as well as complete broadband connections over copper-based DSL, HFC (cable connections), fibre optics and fixed broadband wireless solutions. Despite special features of some connection types like ISDN-PMx, which seem predominantly oriented to the requirements of non-residential customers, the NRA found no distinction between residential and non-residential customers because individual offers for the residential market and business customers do not differ essentially in their structure and their prices. In this market, the following obligations are imposed on the incumbent as regards retail services provided in the context of agreements with a single customer with an annual sales volume which does not exceed the threshold of €500,000: 1) ex-post price control for retail access services; 2) carrier selection and pre-selection; 3) ex-post price control for access services related to carrier selection and preselection; 4) non-discrimination in relation to carrier selection and pre-selection services; 5) transparency applicable to general access conditions related to carrier selection and pre-selection services; 6) requirement to submit agreements related to carrier selection and pre-selection services. Contrary to other NRAs, the German NRA considers it not appropriate to mandate wholesale line rental (WLR). The NRA considers that there would be only a limited demand for WLR, it would bring relatively limited consumer benefits and would not have the potential to spur competition in the market.[403]

402 Commission decision of 31.7.2015 in case CY/2015/1757, C(2015) 5565.

403 Commission decision of 12.7.2013 in case DE/2013/1468, C(2013) 4561 as regards the market definition and Commission decision of 3.7.2014 in case DE/2014/1621, C(2014) 4680 as regards the remedies. The NRA intends to deregulate the retail market as regards access included in bundles with other services (double, triple or quadruple play), for which the incumbent has no SMP. The market review has been notified to the Commission on 15 June 2018, withdrawn and re-notified in October 2019.

6.1.3 Conclusion as regards retail markets

Access is bundled with a volume of calls

Telephone subscriptions are increasingly sold as a service allowing not only to call other subscribers in the same country on fixed and mobile networks, but also making international calls. As regards the latter, a survey found that 26% of the respondents have used traditional means (landline or mobile phone, or SMS) to reach someone in another EU country, about one out of five used mobile phones (18%) and one out of ten used landlines (10%). The survey further showed that a majority of respondents (52%) had phone tariffs that allowed them either a limited (22%) or unlimited (30%) number of minutes for making intra-EU calls. The success of such offerings does not mean that retail markets should be defined differently and include both access to the public telephone network at a fixed location and national and international phone calls. The telephone service continues to be provided or, at least, charged separately from the provision of access. Nearly a quarter (23%) pays a standard per minute rate for making intra-EU calls.[404] Premium rate calls are usually also not bundled with the provision of access.

Even if the number of fixed lines is shrinking or precisely for that reason, competitive entry will remain limited and incumbents will be able to retain a substantial market power thanks to their customer relationship with their not insignificant subscriber basis (see Figure x-x). Competition concerns will likely remain in the short and medium term and require further regulatory intervention at wholesale level (as currently in markets 3a or 3b) to facilitate competitors providing bundles including IP telephony in parallel with the symmetric obligation of number portability under 106 Article EECC.

Table 6-1: Market share incumbents in number of fixed telephone lines 2019

Member State	Operator	Number of lines	Share of total number of lines
EE	Telia Eesti AS	285.997	92.43
LT	Telia Lietuva, AB	351.249	87.68
DK	TDC	410.848	74.61
Austria	A1 Telekom Austria	1.898.721	71,59
LU	Post Telecom	187.700	68,86
CY	Cyta	211.582	68,39

404 European Commission (2019c).

SE	Telia Company AB	1.504.804	62,90
MT	Go plc	161.038	57,28
EL	OTE	2.653.558	55,67
BE	Proximus	2.239.446	54,55
IT	Telecom Italia	10.451.479	51.24
NL	KPN	3.316.318	51,00
HU	Magyar Telekom	1.500.351	48.71
DE	Telekom Deutschland GmbH	18.740.000	48,27
ES	Telefónica de España	8.832.056	45.58
IE	Eir	570.882	39.47
CZ	Česká telekomunikační infrastruktura a.s.	confidential	38,55

Source: BEREC BoR(19)91

<u>In the residential retail market, bundles are there to stay</u>

As regards the residential segment (or market), while wholesale access for carrier selection (call-by-call) and carrier preselection have facilitated retail competition,[405] the success of bundles has created a completely different competitive environment. Competitors prefer to focus their efforts on multi-play offers including broadband internet (offered through the regulated products in upstream markets – such as local loop unbundling and bitstream – or via their own broadband networks).

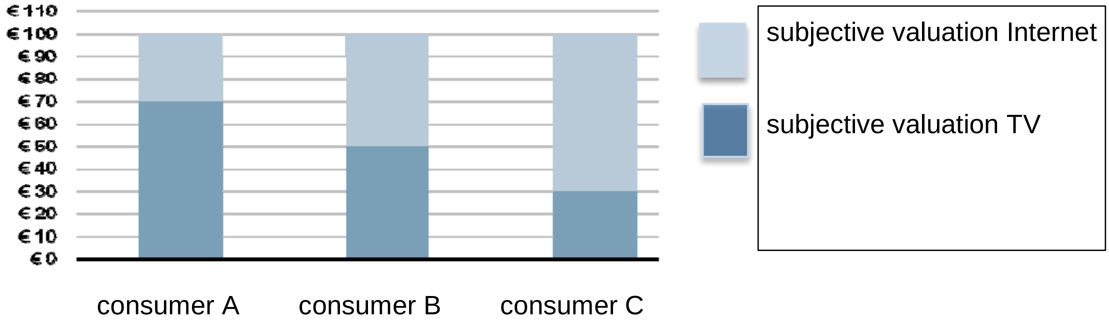
Bundles ensure that subscribers receive better value for money. Indeed, subjective valuation of access to broadband internet and to television programmes varies.[406] If each service is priced €50 in the hypothetical example below, only one consumer will acquire both broadband and television, a second only a broadband subscription and the

405 For example, in 2018, only 3% of call minutes originating in fixed networks (3.2bn of 107bn) were billed by providers using (pre-)selection in Germany.

406 Inspired by Adams & Yellen (1976) and McAfee, McMillan et Whinston (1989), quoted in the Belgian NRA decision of 1 July 2011 regarding the market review of the television broadcasting market in the Brussels region, p.59.

third only IP television, generating a turnover of €200. If both products are bundled and sold for €99, all three subscribers will acquire both products, generating a turnover of €299, or nearly 50%, while enjoying all three a consumer surplus (1%).

Figure 6-2: Consumer preference for double play offers.



The bundling strategy is taken into account by the EECC, which extends mandated number portability to the portability of bundles.[407] However, the bundling strategy also poses particular analytical challenges for the process of market definition in the electronic communications sector, especially since such converged services reflect the bridge that is being built between the respective electronic communications and media sectors, with IP-TV or Cable-TV content offered bundled with electronic communications services. Until this point in time, the Commission's merger reviews have taken the opportunity to leave open the precise market definition for multi-play service offerings.

At the same time, it was inevitable that NRAs would be compelled to provide a definitive market definition with respect to multi-play services. For example, the Irish NRA considered that voice access had to be subdivided in three submarkets:[408]

- Submarket A: Standalone lower level voice access (voice service, including managed VoIP, sold over any type of fixed connection)
- Submarket B: Bundled lower level voice access (voice service, including managed VoIP, sold in a bundle with BB, TV or mobile over any type of fixed connection)
- Submarket C: High level voice access (voice service delivered over ISDN16 or ISDN30 sold on a standalone basis or in a bundle).

The take up of bundles at retail level is not sufficient to conclude the existence of a markets consisting of bundles, because, in parallel, consumers can subscribe separately to the components of the bundle. However, the fact that, in the residential market, competition occurs mainly through bundles has repercussions on possible competitive concerns relating

407 In the past, "(m)ore than half of those who switched providers experienced problems (55%): The most common problems are a delay until all the new services work properly or a temporary loss of service for one day or more (both 21%)" (Directorate-General for Communications Networks, 2018, p.7)
408 Case IE/2014/1629, op.cit.

to consumer choice being restricted at wholesale level. Not only, in the case of integrated operators, may market power in the wholesale voice termination markets entail risks of leveraging. In order to favour their own bundles, integrated operators could for example delay or degrade interconnection provided to competitors in the retail market, who lack sufficient countervailing bargaining power,.

However, for consumers, the volume of voice calls included in retail bundles is likely less decisive for choosing operators than the quality and volume of data. The regulation of markets 3a and b have therefore become the focal point of NRAs to maintain and foster competition in the retail market.

The competition problem in the non-residential market

In 21 Member States retail markets have been fully deregulated. The review of the remedies imposed in the remaining Member States shows that the competition issue relates mainly to the non-residential segment of the access to the PSTN, issue which is likely to be resolved by the transition to full IP-networks. Once stand-alone PSTN lines are no longer available, businesses will increasingly rely on VoIP solutions bundled together with data services, as a result of which alternative offers based on wholesale local and central access products will exert a strong competitive pressure on the retail market for business connectivity.

6.2 Wholesale markets

6.2.1 Might mobile voice substitute for fixed?

The 2014 Recommendation identified two distinct wholesale voice markets: (i) wholesale call termination on individual public telephone networks provided at a fixed location and (ii) wholesale voice call termination on individual mobile networks.

The reason for distinguishing between fixed and mobile wholesale markets was that access via the mobile network was not considered by NRAs as substitutable with access to the public network at a fixed location.

Until now, NRAs continue to distinguish between fixed and mobile wholesale termination markets for the same reason that termination of calls to subscribers of fixed networks cannot be terminated on mobile networks and vice versa. Direct substitution will continue not to be possible.

In its practice under the EUMR, the Commission also concluded that mobile telephony and fixed telephony services do not form part of the same relevant product market, but should instead be considered to be complementary. [409] Where the approaches between regulation and merger control differ slightly, is on the scope of the market: fixed telephony markets under merger reviews include all forms of VoIP as falling within that relevant product market. In control decisions, the Commission has considered two possible sets of segmentation, namely, residential vs non-residential on the one hand, and local national / international calls on the other, while ultimately leaving the market definition open for both sets of segmentations.[410]

Indirect constraints

According to competition law principles, if indirect constraints coming from the downstream (retail market) are strong enough to make the termination rate increase unprofitable for a terminating operator, it might be concluded that this operator does not have SMP on its respective termination market. This could be the case if in the forthcoming period covered by the future recommendation calls to fixed networks could likely be substituted by other means of communication at the retail level, such as calling mobile numbers or vice versa (retail demand substitution). In other words, if the calling party, in order to avoid a pass-through of the wholesale termination charge, instead of calling the fixed number, calls the mobile number belonging to the same person or uses personal communications services provided by OTTs, this may result in a constraint preventing the terminating operator concerned to determine freely its wholesale tariffs.

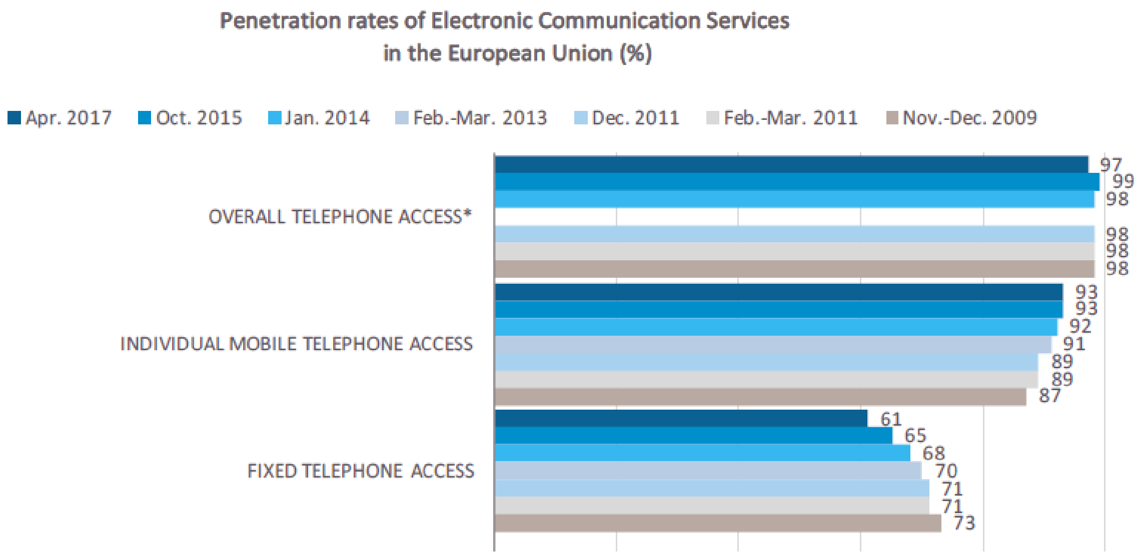
In several decisions, the Commission acknowledged the competitive constraint provided by mobile on fixed voice services, in particular as regards wholesale markets for call origination. The evolution of the mobile operators' market positions over the recent years has contributed to the lowering of barriers to entry, i.e. the first criterion of the three-criteria test, also to the non-residential market for ISDN-multi connections.[411]

Is substitution between fixed and mobile voice sufficient to constrain prices in the medium term?

In less than eight years, fixed telephone penetration decreased by 12 points, while mobile phone penetration increased in parallel by 6 points.[412] The strongest evidence of substitution is that the proportion of households with fixed and mobile access has decreased by six percentage points since October 2015 and is now at its lowest point. Mobile only households continue to increase – up four points since 2015 and 19 points since Dec 2005/Jan 2006. In parallel, fixed line access has been declining in most Member States.

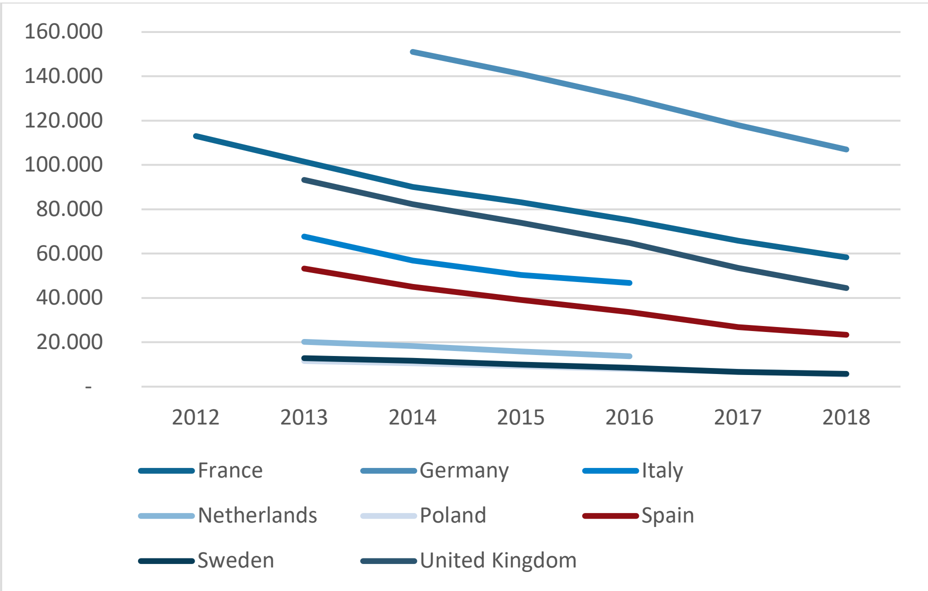
409 Case M.7018.
410 Case M.7421; Case M.7978.
411 See e.g. Case AT/2017/1970, p.8.
412 Directorate-General for Communications Networks (2018, p.4). The figures confirm earlier literature, e.g. Barth and Heimeshoff (2012).

Figure 6-3: Penetration rates of Electronic Communications Services in the European Union (%).



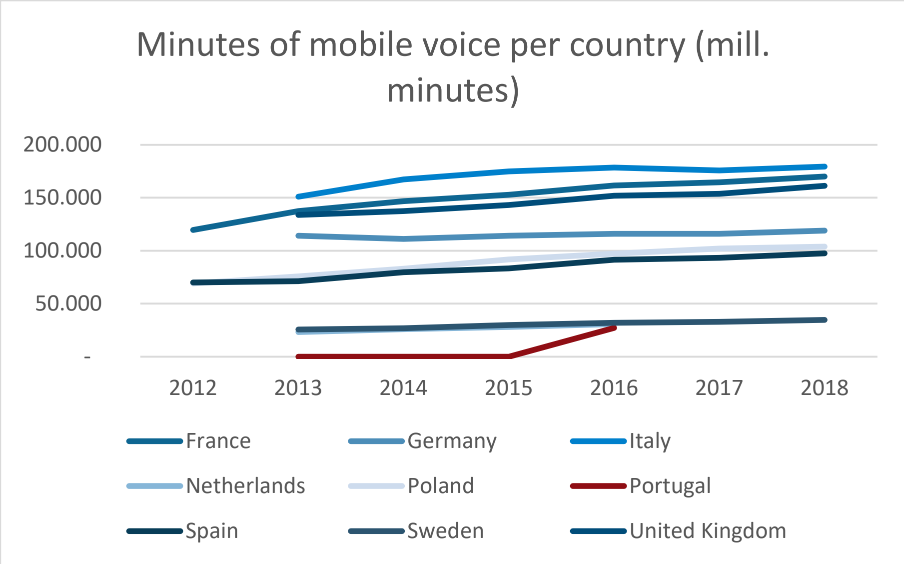
Substitution is one-way,[413] from fixed to mobile: "making or receiving mobile calls is by far the most common daily activity (71%), followed by sending or receiving emails (47%) and sending or receiving SMS (44%). Conversely, daily landline use has declined by six points.

Figure 6-4: Minutes of fixed voice (million minutes)



Source : Ofcom IDATE and NRAs

413 "Substitution possibilities are not necessarily symmetric. Asymmetric substitution describes the situation when substitution between two products only occurs in one direction" (BEREC, 2011, p.12).



However, the daily usage patterns vary considerably among age groups, with 74% of the 15-24 age group using instant messaging services on the Internet versus 17% of the 55+ group."[414] There are also strong differences between Member States: the "proportion of households that only have access to mobile telephony varies widely across Member States, from 87% in Finland to 12% in Malta."[415] Similarly, there is a huge variation across the EU in the proportion of households with fixed telephone access – from 88% in Malta to 8% in the Czech Republic.

While fixed to mobile substitution is clearly evidenced, one cannot assume that over time, the trend will continue at the same pace.

Already today, while the percentage of mobile-only households is continually increasing in the Union, a majority of customers still takes both fixed and mobile subscriptions: more than half of all households have both fixed line and mobile access (54%), while 37% only have mobile access, 7% only have fixed line access. These figures indicate a greater degree of complementarity than of substitutability between these products in most Member States. In 2014, the Commission noted[416] however that since fixed subscriptions are increasingly used to get internet access and additional services such as IP-TV, with fixed domestic voice calls often being provided in the bundle at little or no additional charge, the number of customers who retain both fixed and mobile subscriptions likely overstate the degree of complementarity (as opposed to substitutability) of the respective voice services on those platforms. Double play and triple play bundles are available in all Member States, with an EU average of 31 % and 25 % respectively. Quadruple play is the least used with 11 %. Bundled services are most widely used in Malta, France, Portugal, the Netherlands and Greece (>80 %), while the lowest take-up is in the Czech Republic, Lithuania and Sweden (<30 %). Double play bundles are most popular in Germany (57 %), Greece, Malta and Cyprus, but in almost half

414 Directorate-General for Communications Networks (2018, p.5).
415 Directorate-General for Communications Networks (2018 p.5).
416 CNET (2014, p.21).

of the countries more than 30 % of the households subscribe to such services.[417] In 2017, more than 67 % of EU households subscribe to bundled services.

6.2.2 Is OTT substituting both managed voice and SMS?

Telecoms services revenues have stagnated in Europe since 2015.

Managed VoIP, usually over fibre, cable TV or DSL networks, has been included by NRAs in the same market as the PSTN voice. Unmanaged VoIP is provided as an OTT service but is functionally not a full substitute because the service is mainly used to call or receive calls from other users using the same service. Some OTTs (e.g. Skype, Viber or Google Voice) allow also making calls to numbers in the numbering plan as a paid-for service. Smart speakers, like the Amazon Echo, which are controlled by the user's voice and operate by connecting to the internet are likely to boost the volume of OTT calls to numbering plan numbers.

However, since the EU is capping international calls and SMS within the EU, the possible cost saving is however significantly reduced.[418] Moreover, using the paid-for service not only require online payment via credit card but is sometimes subject to dissuasive conditions for occasional users.[419] But above all, paid for calls to numbers of the numbering plan require a wholesale termination on the network called and their pricing will likely reflect any increase in termination rates. Such services are thus not susceptible to constraint terminating operators in their price setting.

NRAs do, on the one hand, not challenge that about 86% of all Internet users in Europe use OTT communication services.[420] But, on the other hand, NRAs do nevertheless not consider OTT unmanaged VoiP as a substitute for fixed or mobile voice when defining the relevant markets. Firstly because the functionalities are different: in order to make and receive calls, both users[421] need to be logged on to the specific service and have the device (a smartphone, a tablet or a laptop/PC) switched on in order to utilize the service. The second reason is that consumers have limited awareness of changes in the retail price for calls to mobiles. The increasing prevalence and size of inclusive bundles of calls, texts and data at the retail level reduces consumer awareness of the retail price of making a call to a particular mobile number (or mobile number range). OFCOM for example noted that even "for those consumers who may perceive an increase in the marginal price of making a call to a particular mobile number (i.e. if an MTR increase were passed on through call prices), price-

417 European Commission (2019c, p.27)
418 E.g. in November 2019, calling a mobile phone in Italy costs 14.3 c/min on Viber (see Viper, 2019) vs the 19 c/min EU cap.
419 E.g. credits on Viber are frozen after six months and lost in the absence of a connection within 12 months. Moreover Viber provides no guarantee that the credit will remain available. See Viber Payments Policy (Viber 2020).
420 GWI (2019). „Online Activities in the Last Month" - Used a chat or instant messaging service / app.
421 However not all customers will subscribe to an OTT service, and not all customers will subscribe to *the same* OTT service.

based substitution may be unlikely for a number of reasons [among other that] OTT usage is typically relatively infrequent compared to mobile voice calls. Only around 18% of those who have ever used the internet to make voice or video calls do so daily. On the other hand, 70% of mobile phone users make telephone voice calls at least daily (…) [and] studies have found that use of OTT services and "traditional" mobile voice calls are in many cases complementary, reflecting different functionality and quality of service, rather than a price-induced substitution effect".[422] In other words, the reactions of customers in case of a hypothetical termination rate increase are unlikely to make such wholesale price increase unprofitable. Unmanaged voice is therefore not part of the same market.

But although unmanaged voice doesn't affect the definition of the market, its impact on (fixed and mobile) voice services must necessarily be taken into account for the assessment of SMP. According to our data, 26% of calls by consumers in 2017 within Germany were conducted using an OTT communications service. For international calls this share increases to 32%.[423]

In parallel, the increase in mobile data and internet services was accompanied by a decline in voice services (fixed and mobile) and mobile and fixed voice revenues have fallen by 16 % since 2014.[424] In most of the Member States, mobile retail ARPU (including revenues from mobile data) have stagnated or even decreased, showing that the revenues bygone due to increased usage of unmanaged VoIP and messaging, were not compensated by increased data revenues.

Table 6-2: Average revenue per mobile user (ARPU) in selected countries (in €)

	2013	2014	2015	2016	2017	2018	2019
Belgium	15	14	14	15	15	16	16
France	20	18	17	17	16	15	15
Germany	16	15	15	16	16	16	15
Greece	12	12	12	12	11	11	11
Hungary	9	8	9	10	11	11	11
Ireland	23	22	22	22	22	21	20
Italy	11	10	10	10	11	10	10
Netherlands	22	22	21	20	18	18	18
Poland	6	6	6	6	6	6	6
Portugal	10	9	8	7	7	6	6
Spain	20	18	17	15	15	15	14
Sweden	17	18	18	19	19	20	20
United Kingdom	20	19	19	19	19	17	16

Source: IDATE based on NRAs, quarterly reports from MNOs

At the same time, these figures do not necessarily prove that all operators terminating traffic on their networks are constrained and, in the relevant case, to what extent i.e. whether the

422 Ofcom (2017a).
423 Referring to consumers (Arnold and Schneider, 2018).
424 European Commission (2019c).

threat by OTTs prevent the mobile operators to “behave to an appreciable extent independently of its competitors, customers and ultimately consumers”, criterion set in Article 14(2) Framework Directive[425] to conclude the absence of SMP. On the one hand, there is likely to be residual demand for managed voice from business users[426] as well as from residential users without smartphones and for calls requiring any-to-any connectivity and, on the other hand, the burden of proof required by the Commission in order to deregulate markets is relatively demanding, as shown in the case FI/2013/1498.

The Finnish case FI/2013/1498

On 2 October 2013, the Commission, pursuant to Article 7(4) of the Framework Directive, informed FICORA that it had serious doubts as to the compatibility of the NRAs intended withdrawal of the existing SMP designations and ex ante obligations in the fixed call termination market (market 3/2007), because fixed-mobile substitution in the downstream retail market arguably constrained wholesale fixed termination rates. Despite the 31 individual public telephone networks provided at a fixed location concerned by the draft measure had each 100% market share for terminating calls in their networks, the NRA considered that an increase in termination rates would be unprofitable thanks to the high mobile usage in Finland.[427] In case of increase of fixed tariffs, the users would make calls to mobile networks, away from the fixed network that raised its wholesale call termination charges.

According to the Commission and BEREC, the regulator did not present sufficient quantitative evidence to support its arguments based on ‘indirect constraints’. In particular, the NRA must demonstrate that:

- wholesale price increases would be passed through to retail prices; and
- a sufficient demand-side substitution at the retail level that would render the wholesale price increase unprofitable.

Consequently, the NRA must quantify the impact of increased FTRs on retail prices and provide data to demonstrate that other operators would not, at least partially, absorb the price increase in their margins.

As regards the demand side substitution, the Commission noted the important difference in the shares of residential and non-residential users who have both fixed and mobile subscriptions, respectively 13% and 54% and argued that the NRA should have better

425 Carried over in Article 63(2) EECC.
426 In the UK, the NRA notes that “96% of businesses use landlines and 64% consider their voice service absolutely vital (overall 97% consider landlines absolutely vital, very important or somewhat important) (Ofcom, 2017b).
427 According to the NRA, fixed-only customers represented only 1% of residential users and 2% of business users.

analysed the behaviour of customers who are less susceptible to switching services in response to an FTR increase (e.g. public authorities, banks and hospitals).

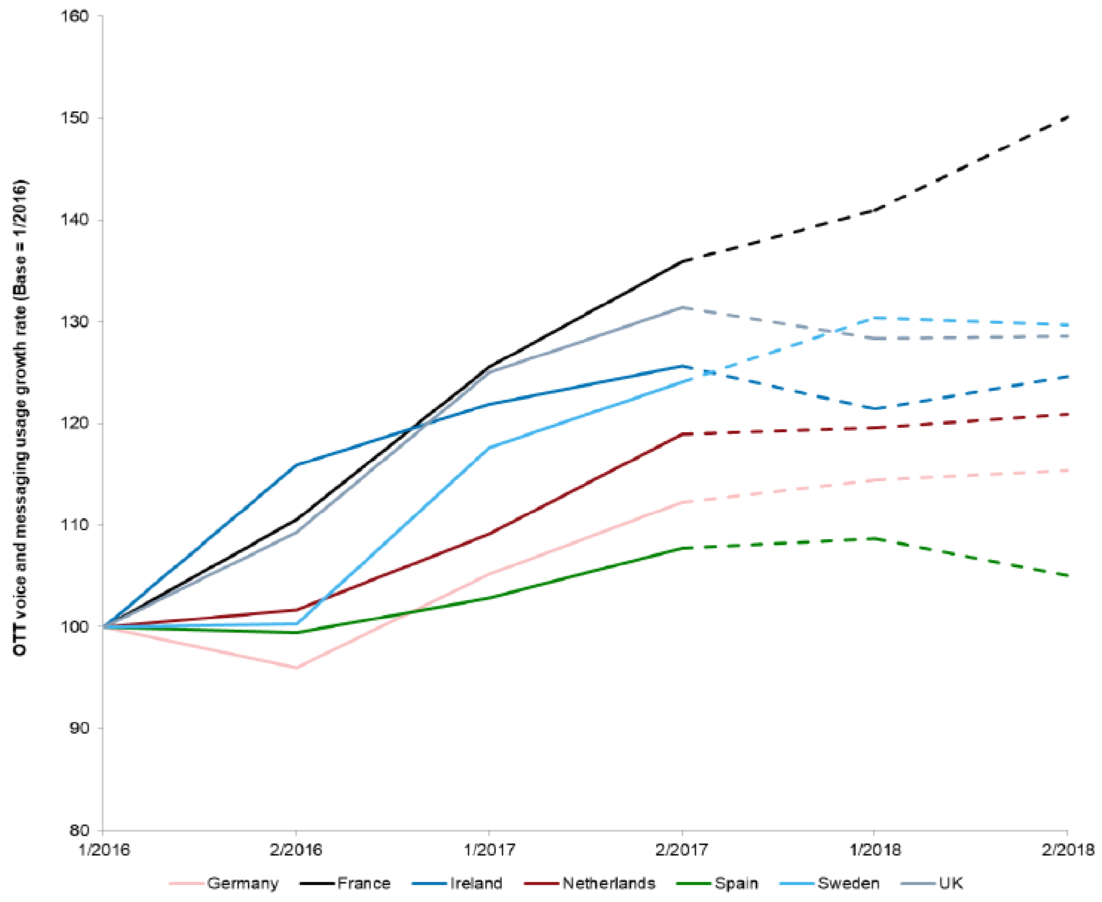
The Commission therefore concluded that even though some fixed-mobile substitution may occur, the NRA had not sufficiently demonstrated that a rise in fixed termination rates would be unprofitable for fixed operators. The Commission mentioned that for example, it may be profitable to raise the fixed termination rate up to the level of the mobile termination rates (the difference between the two being small: 0.38 €cents).

<u>Application of the Commission's criteria to estimate indirect constraints from unmanaged OTT voice on mobile (and fixed) termination</u>

OTT unmanaged VoIP may exert pressure on mobile (and fixed) operators to the extent that the latter are constrained in their price setting. However, on the retail markets operators usually bundle access and a volume of minutes or a volume of minutes with volumes of SMS and data. For this reason, subscribers will not necessarily be aware of the level of the wholesale termination rates. As a consequence, , it is difficult to conceive that in the coming years OTTs could exercise sufficient indirect constraints on the retail market to affect the market definition.

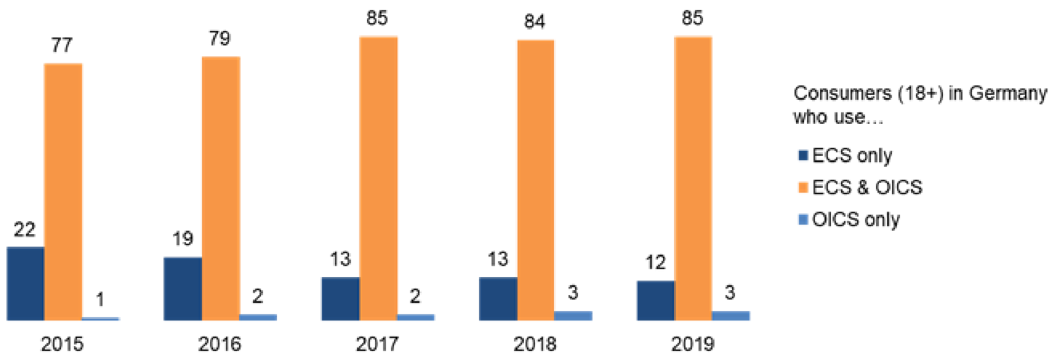
As a matter of fact, while replacement of certain calls with OTT and vice versa has undoubtedly occurred, there is evidence to suggest that OTT is unlikely to further replace traditional mobile communications services domestically or when roaming. In particular, the latest WIK data for Germany and other EU countries points towards a stagnation in the number of users of interpersonal communications services offered by OTT players as well as a corresponding stagnation in the number of users who only use telephony and SMS offered by fixed and mobile operators, the majority of users seeing both as complements rather than as substitutes.

Figure 6-5: Percentage of all internet users using OTT voice and messaging (growth expressed with base = 1/2016)



Source: WIK estimates based on data provided by the GWI on usage of Facebook Messenger, Instagram, Snapchat and WhatsApp for interpersonal communication.

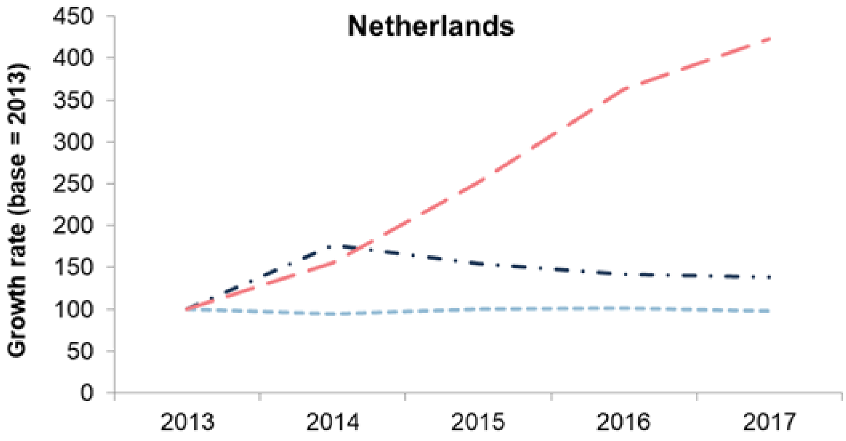
Figure 6-6: Interpersonal communication channel choices in Germany - traditional ECS versus OICS services in percent



Source: WIK

The data regarding the Netherlands also show that the dramatic increase of the penetration of messaging service users as percentage of all internet users does rather complement than replace voice communications. Recent data regarding Germany also confirms the resilience of voice communications despite high penetration of OTT voice and messaging amongst the German internet users.[428]

Figure 6-7: Growth of SMS, Telephony compared to that of the take up of OTT voice and messaging by internet users in the Netherlands (Base: year 2013)



Source: WIK

Moreover, RCS - for Rich Communication Services having a built-in messaging service that can send messages across operating systems via a data connection could, over the next decade, negate the need for a standalone app that serves the same purpose. Since RCS is essentially a number-based interpersonal communications service and a SIM-Card is mandatory for the authentification procedure as well as the distribution of messages, it can be expected that mobile operators will retain a relatively strong link to the RCS featured on their customers' devices. Consequently, one can forecast that, to a certain extent, RCS will fence off mobile network operators from substitution by OTT messaging apps.

6.2.3 Foreseeable technological evolutions and their potential impact

Migration towards all-IP networks and PSTN switch-off

Over the last decade, a technology transition has been underway as telecoms providers have begun to transfer services to modern Internet Protocol based networks (IP networks)

428 "Das normale Telefongespräch boomt in Corona-Zeiten weiter: Im Festnetz verzeichnen wir für die vergangene Woche einen Anstieg um 26 Prozent gegenüber einer normalen Woche. Im Mobilfunk wächst der Telefonverkehr um 25 Prozent gegenüber einer normalen Woche. Er nimmt im Vergleich zur Vorwoche aber um 4 Prozent ab. Der Datenverkehr im Festnetz steigt gegenüber einer normalen Woche nur noch leicht um 2 Prozent – im Vergleich zur Vorwoche geht das Datenvolumen sogar minimal zurück. Im Mobilfunknetz sinkt der Datenverkehr um zwei Prozent im Vergleich zu einer normalen Woche." (Vodafone, 2020b) which use a common infrastructure for both broadband and telephone services. IP-based managed voice is today considered a substitute for PSTN voice, and will therefore become the default option in the years to come. The migration should not impact on the range of regulatory obligations: e.g. copper access obligations such as WLR will persist in the UK.

Major investments have been undertaken by incumbents to migrate their copper-based networks to fibre. This migration brings about the phasing out of the traditional fixed line telephony. Fixed-analogue services and traditional fixed lines and calls will cease to exist in the coming years. As of 2018, full transition to VoIP with PSTN switch-off had occurred in Germany and Estonia, with near full transition in the Netherlands. In contrast, there is limited VoIP in the UK except for new build/FTTH and some business, but Openreach announced that it will be withdrawing its PSTN and ISDN networks in December 2025.[429] Italy and Poland also start from a low base of VoIP lines.

When examining price evolutions, NRAs will need to take into account that voice price increases may be due to fibre investments and not to lack of competition. For example, in the UK, the price of calls in all voice services (excluding calls from mobiles) are regularly increasing as the cost to run legacy network services increases, in parallel with the migration of fixed line voice services to Hosted Voice and SIP based services.

Another regulatory incidence of the migration to IP networks is that the points of interconnection will usually change. Unlike circuit switched networks, IP networks do not have dedicated switching functions to connect calls. Instead, calls are encoded as IP packets and conveyed across a common IP network infrastructure that is used for all services. Another difference is that IP networks usually only have a small number of Points of Interconnection (POI) located at core network nodes which are remote from most end-users' fixed lines. Moreover, they use different communications protocol. Translation is therefore required to facilitate interconnection between circuit switched and IP networks. This translation is carried out by equipment called a media gateway, adding to the cost of interconnection.

The migration to all IP fixed networks is concomitant to mobile network operators introducing only IP-voice services through 4G VolTE. VoLTE builds on the IP Multimedia Subsystem (IMS) and is closely linked to the Rich Communication Services (RCS) suite. These migrations will foster all IP core networks supporting both fixed and mobile calls, leading to fixed-mobile convergence at the supply-side, at least in the case of mobile operators. This evolution will change the way calls are set-up and delivered, but not the notion of call termination. At the same time, this trend towards convergence pleads for greater harmonisation of fixed and mobile termination rates.

Transition to all-IP is a pre-condition for copper switch-off, but can occur independently.

429 Ofcom (2019b), and Digital Wholesale Solutions (2019). See also ISPreview (2019e).

6.2.4 Conclusions on the scope of the relevant voice markets

Under competition law, markets are defined in order to identify and define the boundaries of competition between firms and assess market power or, in the case of the EUMR, to identify overlaps between activities of merging undertakings. The definition of markets under Article 64 EECC has also another aim: limiting asymmetric regulation to the areas where the latter are “necessary and proportionate for achieving the objectives” set out in Article 3(2) EECC.

Etiology of the call termination market

The narrow market definition of the wholesale call termination markets is the outcome of a regulatory evolution initiated by the regulation of ‘interconnection charges’ under 1997 interconnection Directive[430]. This Directive aimed to ensure a minimal harmonization of the national approaches to the regulation of termination rates in the context of the market liberalization, where ‘incumbents’ controlled an overwhelming share of end users and the main issue was to ensure effective interconnection of new entrants to the networks of the incumbents, including for call origination. The Directive principally left interconnection as a matter for commercial agreement, but required operators with significant market power to offer cost-oriented interconnection. The Directive did not mandate a particular type of costing methodology to be applied. However, noting strong divergences between approaches of NRAs, the Commission published successive recommendations to ensure more consistency.[431]

Under the 2002 Regulatory Framework, regulated interconnection of fixed public switched telecommunications networks governed until then by Art 7.1 interconnection Directive, was carried over through the definition of three corresponding wholesale markets: call origination in the fixed public telephone network, call termination in the fixed public telephone network and transit services in the fixed public telephone network. The regulation of interconnection to mobile public switched telecommunications networks (linked to national market for interconnection) under Article 7(2) interconnection Directive was carried over through the definition of the markets for call origination on public mobile telephone networks and for call termination on public mobile telephone networks. The reasoning in support of defining these markets was that the “main elements required to produce or supply retail telephone service are call origination, call conveyance (including routing and switching) of varying kinds and call termination.”[432] As regards, call termination on fixed networks, no alternative market definitions were contemplated in the absence of “possibilities for demand and supply substitution that might constrain the setting of termination charges on a given network”.[433] For call termination on mobile networks, the Commission contemplated “a national market for (mobile) call termination but the supply side substitution necessary for such a definition does

430 European Parliament (1998).
431 E.g. European Commission (1998a) and European Commission (1998b).
432 Commission Memorandum, p.18.
433 Commission Memorandum, p.19-20.

not currently exist."[434] With other words, "substitution that might constrain termination charges and also the behaviour of network operators in setting termination charges."[435]

One of the most important factors in the determination of the relevant product market is the degree of substitutability.[436] However, a competition law analysis "cannot be limited solely to the objective characteristics of the relevant products and services, but the competitive conditions and the structure of supply and demand on the market must also be taken into consideration".[437] In the case of call termination, the structure of the market is primarily shaped by the legal obligation on all network operators to interconnect with each other in order to ensure provision and interoperability of services throughout the Union.. A mere reading of the legal framework suffices to conclude that termination on network A and network B are complements[438], not substitutes. The EU case law links the 'special duty' of dominant undertakings not to engage in conducts that may distort competition, to the fact that "as a result of the very presence of the undertaking in question, the degree of competition is weakened"[439]. In the case of termination, the degree of competition is weakened by the regulatory obligation which prevents operators to refuse providing interconnection to operators setting excessive termination rates, not by the presence of any of the undertakings providing call termination.

From an economic point of view, "there are conceptual concerns as to the robustness of applying a SSNIP test in the context of a vertical value chain where the contribution of the wholesale input to the retail is limited (i.e. under low pass-through)".[440] The main rationale for the narrow market definition was summarized by the Commission: "all operators are

434 Commission Memorandum, p.34. The Memorandum obviously did not examine the potential of the wholesale mobile termination and the (retail) mobile access market to constitute a single market as did Valletti (2006, p. 61)

435 Commission Memorandum, p.32.

436 See Case 66/86, Ahmed Saeed Flugreisen v. Zentrale zur Bekampfung Unlauteren Wettbewerbs [1989] par.135: "The test to be employed is whether the scheduled flight on a particular route can be distinguished from the possible alternatives by virtue of specific characteristics as a result of which it is not interchangeable with those alternatives and is affected only to an insignificant degree by competition from them."

437 Commission Decision of 29.04.2014 in Case AT.39985 - Motorola - Enforcement of GPRS standard essential patents par.180. In that antitrust case, the Commission used however a similarly truncated market definition, with the aim to show that the undertaking in question is dominant. By defining the relevant market as the licensing of a standardised technology, the patentee will inevitably hold a market share of 100 %, due to the exclusivity of its standard-essential patent. A similar reasoning was used in the litigation subject to the preliminary question of C-170/13 Huawei Technologies Co. Ltd v. ZTE Corp.(2015) EU:C:2015:477. Unfortunately, the ECJ did not analyse the question of dominance and market definition because, as advocate general Wathelet points out: "the referring court proceeds on the assumption that Huawei holds a dominant position and has not asked the Court either about the criteria for determining the relevant market or about the finding of a dominant position" (EU:C:2014:2391 (2014), par.53).

438 Telecommunications operators are legally obliged to interconnect with all other operators on reasonable demand. Differences between the call termination offered by each operator do no more matter for them, than differences between different types and dimensions of tyre were important for dealers, who must meet demand from customers for the whole range of heavy vehicle tyres, in the Michelin case (Case 322/81, EU:C:1983:313 (1983) par.44).

439 Judgments in *Hoffmann-La Roche* v *Commission*, 85/76, EU:C:1979:36, par. 91; *AKZO* v *Commission*, C-62/86, EU:C:1991:286, par.69; and *Tomra Systems and Others* v *Commission*, C-549/10 P, EU:C:2012:221, par.17.

440 Okholm and Basalisco (2013, p.22).

monopolists for the termination of calls on their networks and normally have the ability and incentive to raise termination rates above costs".[441]

In reality, the question of market definition in (mobile) call termination was intrinsically linked to the issue of whether a regulation of termination charges is required.[442] The narrow market definition was necessary under the Framework and Access Directives, because these Directives did not provide other tools to deal with the "two-sided platform" characteristic of voice communications in liberalized markets, characteristic which results from the currently used regime for voice in Europe: calling Party Network Pays (CPNP).[443]

Before the adoption of the 2002 framework, the 1997 Interconnection Directive defined SMP in respect of cost-orientation applies to the national market for interconnection (i.e. market covering all fixed-fixed as well as fixed-mobile and mobile-mobile interconnection). However, in the meantime, the customer base of new entrants exploded, particularly in the mobile market. However, on the overall 'termination market' most mobile operators did not reach a market share sufficient to subject their wholesale charges for terminating traffic to cost-orientation, leading to 'bill shocks' and pressure on NRAs to intervene. Moreover, the absence of regulation of mobile call termination lead to different per-minute prices for on-net and off-net calls, which, according to the economic literature, "distorts consumers' marginal rate of substitution between on-net and off-net calls, and introduces a consumption inefficiency."[444] The UK's NRA was the first to propose[445] the alternative market definition, eventually taken over in the 2003 Markets recommendation. The new market definition led to a quasi-automatic finding of dominance on the markets for termination on individual networks and, over time, to the extension of the regulation of the termination rates from the fixed incumbents to all market players terminating calls on their network, whatever their size.[446]

6.3 Proportionality assessment

6.3.1 Is there a need to regulate call termination under the SMP regime?

In principle, the starting point of the assessment should be whether network operators could theoretically increase wholesale termination rates without risking that on the retail level end-users would switch to, for example, OTT calls in response, making the increase unprofitable.

441 European Commission decision in case DE/2009/0948 – Remedies for Alternative network operators in the markets for Voice call termination on the public telephone network at a fixed location in Germany, p.4.

442 Market were also defined narrowly in other infrastructure related cases likely for similar reasons: "The fact that markets are narrow rather than broad does not in itself indicate that market definitions are right or wrong. But in some of these cases, narrow markets seem to be serving the particular end of imposing public utility-like duties to provide access to facilities thought to be important to the public, and to do so as a matter of EC law. This may reflect sound public policy, but it is not necessarily a policy focused solely on competitive concerns." (Kauper 1996, p.1704)

443 Recital 195 EECC. See also Bomsel (2003, p.9).

444 I.a. Laffont, Rey and Tirole, quoted by de Bijl and Peitz (2000, p.28).

445 Director General of Telecommunications (2011).

446 The Commission was instrumental in this extension. See e.g. Commission vetoes decision by German regulator on call termination in fixed telephone networks, IP/05/564 Brussels, 17th May 2005

As we have seen, this scenario is not likely. The usage patterns of OTT calls differ between Member States and between categories of users. Nevertheless, the following elements will play in all Member States. First, at the demand side, end-users will not immediately be aware of the increase of wholesale termination rates, even if reflected in the per minute cost of calls to subscribers on the network concerned. The reason is that calls are generally part of contracts that, in the case of fixed subscriptions, bundle the access with a volume of calls, and in the case of mobile subscriptions are bundling a volume of calls with volumes of data and SMS. Until the exhaustion of the contractual volume of calls, end-users will generally not feel concerned by increases in the call charges. Moreover, as mentioned above, WIK data for Germany and other EU countries show stagnation in the number of users of interpersonal communications services offered by OTT players, meaning that the share of users who effectively could switch to OTT voice might be substantial but is not expected to include all users, and thus leaving a significant share of users that can only be reached via voice calls. In addition, many public services can only be reached by voice calls.

Second, at wholesale level, it is far from certain that the operators will bluntly pass on the increase by reducing the volume of calls. If all operators would increase their termination rates – but such hypothesis falls outside of the ceteris paribus assumption of a traditional SSNIP test – one could expect that flagship offers in the retail market would encompass a lower volume of calls and a higher volume of data. Consequently, at medium term, the volume of voice calls would go down and the profitability of the wholesale call termination increase be reduced. However, in a ceteris paribus scenario, such impact on the commercial strategy of operators would only be likely if the operator increasing its termination rates represents a significant share of calls.

In such circumstances, it is likely that, in the absence of regulatory obligations other than those imposed under the SMP regime, the termination markets would further fulfil the three criteria.

6.3.2 The current regulatory context

To decide whether there is need for ex ante regulation of the interconnection market, one should take into account existing market conditions as well as expected or foreseeable market developments over the course of the next review period in the absence of regulation based on significant market power; this is known as a Modified Greenfield Approach. In particular, the analysis must take into account the effects of other types of (sector-specific) regulation, decisions or legislation applicable to the relevant retail and related wholesale market(s) during the relevant period.[447]

A major difference with the previous reviews of the Commission recommendation on the markets susceptible of ex ante regulation is that Article 75 EECC now addresses the ability

447 European Commission (2018b, par.18).

and incentives of terminating operators to raise prices substantially above cost, market power that results from the CPNP principle. Under this provision, the Commission establishes, by means of a delegated act, a single maximum voice termination rate for mobile services and a single maximum voice termination rate for fixed services that apply Union-wide (Eurorates).

However, BEREC reminds that “besides the Eurorate, other remedies (especially but not limited to access, transparency and non-discrimination) could be necessary to ensure effective competition in markets downstream of the termination markets. This is because in certain cases, even in the presence of a Eurorate, operators could provide access under discriminatory (quality-wise) or under non-transparent conditions (especially when these services are provided to small operators). Similar issues can arise regarding ancillary services, such as co-location or interconnection kits. In addition, there could be situations where these issues require an asymmetric regulation (closure/move of points of interconnection, reference offer, transition to IP interconnection).”[448]

Indeed, Article 75 EECC concerns only the termination market stricto sensu.[449] Wholesale call termination encompasses the service by a fixed or mobile operator consisting in completing calls from customer of other networks. The overview in the subsequent paragraphs of the SMP remedies imposed in the termination markets, show however that a substantial part of these remedies relates to services or facilities that are related to the termination of calls, but not part of the service, such as the definition of the place of interconnection, the tariffing of interconnection ports or collocation of equipment.

Once Article 75 EECC is implemented, the product markets where competition distortions can be expected may no longer be the termination markets, but a newly to be defined interconnection market, including all services or facilities that interconnecting operators offer to each other, enabling call traffic to be conveyed from one network to another.

The product definition needs to start from the obligation under Art. 60(1) EECC on all operators, when requested, to negotiate with each other interconnection for the purpose of providing publicly available electronic communications services, in order to ensure provision and interoperability of services throughout the Union. This obligation could suggest that the provision of interconnection by each operator constitutes a distinct market. In practice, this is not the case, because operators can also make use and make use of indirect interconnection.[450] In Member States with a large number of operators direct interconnection would require n(n-1)/2 interconnection agreements. Indirect interconnection or interconnection exchanges will generally be more efficient for interconnection, in particular

448 BEREC (2019b, p.9).

449 « As regards the market for mobile termination, this is composed of the markets for termination offered by each MNO and full MNVO3 that can negotiate call termination charges with other mobile operators independent of their host mobile network operator.” Explanatory Memorandum 2014 Markets Recommendation, p. 28.

450 Some NRAs examined such potential substitution in the past. For example, in Latvia « (…) in its market definition, SPRK itself concluded that transit was not an effective substitute for call termination» see Commission decision of 3 April 2009 in case LV/2009/0889, p.4.

for smaller alternative network operators and MVNOs. It falls outside of the scope of this study to identify the operators of networks to which other operators need a direct interconnection. NRAs will need to examine, at national level, the possible substitution of direct by indirect interconnection in order to define the interconnection markets in their jurisdiction. Interconnection to networks of each operators acting as “interconnection hubs” will constitute distinct markets, if these operators could impose a profitable significant increase in their transit pricing. This will be the case if the level of migration costs for the alternative network operators concerned would be susceptible to dissuade them to migrate to another hub in case of price rise. And even if there would be a single interconnection market encompassing interconnection to several networks (typically, the incumbent fixed operator and major MNOs), one of these could enjoy market power in case of persistent high market shares over time.

The next question is whether these interconnection markets would pass the three criteria test, taking into account the broad powers conferred under the EECC to NRAs under Article 61(2)(a) to ensure ‘end-to-end connectivity’ and when settling disputes under Article 26 relating to the interconnection obligation under the above Art. 60(1) EECC.

From a general EU wide perspective, it would appear that these powers are sufficient to conclude that the second criterion is not fulfilled. However, particular circumstances, such as the migration to IP networks and the resulting uncertainty on interconnection points and timing, could require ex ante measures that would be difficult to impose under Article 61, because of the need to provide interconnecting parties clarity in due time on the migration process and its consequences. Conversely, when the risk is that interconnection negotiations could result in unfair or inefficient interconnection terms, horizontal remedies would seem sufficient.

In the sections below, we will review asymmetric obligations currently in force regarding SMP operators in the termination market, but relating to interconnection services and facilities, and see whether these obligations could be carried over based on Article 61.

6.3.3 Obligations of access to, and use of, specific network elements and associated facilities (Art.73 EECC)

6.3.3.1 Obligations imposed

All NRAs impose obligations of access on all operators of individual public telephone networks, whether mobile networks, whether provided at a fixed location.

The access obligations on the incumbent fixed operators are generally more detailed, among other in relation to the interconnection points that need to be made available during the transition to all IP-networks. For example, in Austria, where A1 Telekom has specific obligations regarding the points of interconnection provided, in Romania, where the fixed incumbent had to offer IP interconnection by 1 May 2019 or in Belgium, where Proximus is subject to send a formal closure notice one year in advance.

The Estonian NRA[451] also distinguishes between the access obligations imposed on the fixed incumbent and on the alternative network operators: the first is obliged to provide access within two months upon reasonable request, including co-location or other forms of facility sharing, including sharing of ducts, buildings or masts, for the purpose of providing call termination services, whereas smaller fixed operators have six months from the access request.

In France, the NRA imposed[452] a number of specific obligations in order to support the rationalisation of operators' NGN architecture and IP interconnection: (i) an operator can only request another point of interconnection when the capacity on existing ones has been exhausted; (ii) operators can request a single point of interconnection when they have fixed and mobile activities and/or are part of the same group (so-called "mutualisation" of the points of interconnection). According to the NRA, these obligations are justified to reduce entry barriers and interconnection costs for smaller operators.

But generally, the access obligations imposed on all regulated operators consist in the requirement to meet reasonable requests for access to, and use of, specific network elements and associated facilities, including the obligation to sufficiently unbundle the access provided to ensure that parties seeking interconnection are not required to acquire services or pay for facilities which are not necessary for the service requested and the obligations to commit to SLAs. Taking into account the investments already made by parties to interconnection agreements in force, several NRAs moreover require operators not to withdraw access to facilities already granted, in the absence of previous agreement with the interconnecting party or authorisation by the NRA.

All these obligations could legally be imposed ‘ex ante’ by the Member States[453] as part of the general authorisation (under Art.13 & Annex I EECC). Specifically, Member States are allowed to provide for “access obligations other than those provided for in Article 13 applying to undertakings providing electronic communications networks or services” (Part A (7)) and, as regards, network operators, obligations regarding the “interconnection of networks in accordance with this Directive” (Part B (1)). Finally, Member States may attach conditions to rights of use for numbering resources relating to the “designation of service for which the number shall be used, including any requirements linked to the provision of that service and, for the avoidance of doubt, tariff principles and maximum prices that can apply in the specific

451 Decision of 3.10.2018 in Case EE/2018/2112: Wholesale call termination on individual public telephone networks provided at a fixed location, C(2018) 6587, p.3 and decision of 29.4.2019 in Case EE/2019/2158: Wholesale voice call termination on individual mobile telephone networks, C(2019) 3397, p.3.

452 Decision of 27.11.2017 in Cases FR/2017/2028: Market for wholesale call termination on individual public telephone networks provided at a fixed location.

453 Art 5(1) EECC makes clear ‘a contrario’ that ‘general authorisations’ are in principle not part of the portfolio of NRAs (“Member States may assign other tasks provided for in this Directive (…) to national regulatory authorities, in particular, those related to (…) market entry, such as general authorisation (…)).

number range for the purposes of ensuring consumer protection in accordance with point (d) of Article 3(2)” (Part E (1)).

These provisions contain nevertheless a number of limits: a) conditions relating to interconnection of networks and interoperability of services must be ‘in accordance with” the EECC. In practice, Annex I refers to Article 60 which requires Member States – when transposing the provision – to ensure that operators public electronic communications networks have effectively the right and, when requested by other undertakings, a legal obligation – that can effectively be enforced - to negotiate with each other interconnection for the purpose of providing publicly available electronic communications services, in order to ensure provision and interoperability of services throughout the Union. Today, generally formulated access obligations are imposed in the framework of market reviews, subjecting the transposition of Article 60 to the intervention of NRAs. Strictly speaking, obligations should be imposed on all network operators immediately in their general authorisation, without making such obligations dependent on SMP finding[454].

6.3.3.2 Specific obligations imposed on certain SMP operators

The assessment in previous paragraph concerns general obligations applicable to all network operators. However, access obligations encompass in particular as regards the fixed incumbent requirements relating to network architecture, timing of availability of Points of Interconnection (POIs) etc. Such obligations are ‘specific obligations’ referred to in Art.13 EECC. Specific obligations can only be imposed by NRAs and only under (the national provisions transposing) Art.61(1) and (5) and Articles 62, 68 and 83 EECC.

The competent authority and the procedure for imposing access obligations under Art.61(1) and (5) – i.e. without SMP finding – and under Art.73 – SMP remedy – are the same: only NRAs can impose such obligations and (ii) only after public consultation and going through the internal market procedures. Moreover, as the Court clarified under the corresponding provision in the Access Directive that NRAs may intervene “without defining or limiting the detailed rules for that intervention”.[455] What differentiates both competences of NRAs is the objective pursued. NRAs may only impose access obligations under Art.61(1) and (5) in order to secure “adequate access and interconnection and interoperability of services in the interest of end-users”.[456] Conversely, SMP obligations seek to “ensure the development of a competitive market, the conditions of which favour the deployment and take-up of very high capacity networks and services, and the maximisation of end-user benefits.”[457] Specific obligations on incumbent fixed operators, relating to their migration from TDM to IP

454 Which is making conditional the right granted unconditionally under Article 15 (2) to: “(a) negotiate interconnection with and, where applicable, obtain access to, or interconnection from, other providers of public electronic communications networks or publicly available electronic communications services covered by a general authorisation in the Union in accordance with this Directive”.
455 Case C-192/08 *TeliaSonera Finland* (November 2009) EU:C:2009:696 , par.60.
456 Recital 144 EECC.
457 Recital 161 EECC.

architecture are justified by the supervision of interconnection by NRAs to ensure efficient interconnection and give full effect to the interconnection rights and duties (i.e. rationalizing the interconnection processes). Similarly, imposing obligations on colocation and interconnection links, including their pricing, can be justified by an efficient interconnection objective.[458] There is a significant overlap between measures aimed at protecting competition and measures aimed at ensuring effective and efficient interconnection and end-to-end operability. The latter measures will indeed generally also result in making life of competitors easier, by facilitating access. Moreover, under Art.61(1) NRAs are required to exercise their responsibility also in a way that promotes sustainable competition (as well as "the deployment of very high capacity networks, efficient investment and innovation, and gives the maximum benefit to end-users").

A second distinction between both tools available to NRAs is at what stage the respective tools can be used. In the case of Art.73 EECC, the trigger is a market review and the finding of dominance. In the case of Art.61(1) and (6) EECC, the recital suggests that intervention is possible "where commercial negotiation fails".[459] However, recitals are not prescriptive and Member States are not bound by the recitals when transposing a directive, but by its objectives. In addition, when negotiations fail is a factual question at the discretion of NRAs. Given that under Art.61(6) NRAs should be empowered to intervene on their own initiative, they do not have to wait for a complaint from one of the negotiating parties. NRAs may intervene as soon as they deem it "justified in order to secure the policy objectives of Article 3". Intervention under Art.61(1) and (6) EECC would provide a timeline much shorter than competition law or SMP 'ex ante' remedies. Contrary to competition law investigations, NRAs would have no obligation to show any breach, but only to need to intervene to guarantee effective interconnection. Contrary to the market review, the procedure would not involve a long process of consultation of market definitions and SMP finding, but could be started as soon as there are indications that commercial negotiations are not likely to achieve efficient interconnection conditions in the interest of the end-users. In addition, NRAs must under Art.61(1) "provide guidance and make publicly available the procedures applicable to gain access and interconnection to ensure that small and medium-sized enterprises and operators with a limited geographical reach can benefit from the obligations imposed". In this context, the NRA must not only foster interconnection by operators already active on the market but also the entry of any other operator "authorised to provide public electronic communications network or an associated facility"[460]

A more delicate question is whether national courts will share the above legal interpretation. There is one precedent where a national court seemed to rule differently. On 27 February

458 During the public consultation on the review of the Recommendation on Relevant Markets, the German company, United Internet advocated further regulation because the incumbent could degrade interconnection by delaying delivery capacity, making too little capacity available, not allowing altnets to interconnect and abusing their transit role (WIK-Consult, Summary EC consultation (2019) p.7). Prohibition of such behavior by the NRA would fall within its competence to settle disputes or could be the subject of an own initiative decision under Art.61(1) and (6) EECC.

459 Recital 144 EECC.

460 See Art.2 (29) EECC which defines 'operator' as « an undertaking providing or authorised to provide a public electronic communications network or an associated facility »;

2013, the highest administrative court (Verwaltungsgerichtshof) in Austria ruled that the general access obligation (combined with potential need of dispute resolutions)[461] was not sufficient to guarantee effective access and could not substitute for specific access obligations under the SMP regime.[462] However, the judgment needs to be read in its context. First, the court based its reasoning on the comment issued by the Commission during the Article 7 procedure that “commercial agreements cannot always ensure that customers are at all times connected to all networks. Under certain circumstances operators may temporarily refuse the termination of calls, inter alia, in order to foreclose the market for specific forms of interconnection. Therefore the Commission invites TKK to impose effective access obligations also on ANOs”.[463] Second, the NRA had in the consultation procedure concerned not submitted any access obligations under the equivalent at the time of Art.61(1) EECC. The situation would have been very different if the Austrian NRA had notified the access obligations concerned under the latter provision or had convincingly argued that until then no commercial interconnection negotiation (with alternative network operators) ever failed in Austria and that there were no indications that this situation could change during the review period.

6.3.3.3 Dispute resolution as a complement of general authorization conditions

Except in the case of the specific access obligations imposed on the incumbent fixed network operators, which would require a pro-active intervention from NRAs under Art.61(1) and (6), most of the current access obligations could be replaced by a combination of including general access obligations in the conditions attached to general authorisations, combined with dispute resolution under Art.26 EECC. Although all undertakings depend on bilateral agreements with others to deliver their narrowband services and all have an interest in effective end-to-end operability, significant differences in market shares at retail level are likely to persist, as well as differences in terms of size of network owned and preferences as to interconnection points. As a consequence of the resulting differences in negotiating power, some operators will likely submit disputes on the interpretation of interconnection rights and obligations under the general authorization to NRAs.

Precedents of dispute resolution procedures relating to the interpretation of generally phrased SMP obligations in Member States like France provide a good illustration of the effectiveness of the approach. For example, in 2018 the French NRA settled a dispute

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461 “da geschäftliche Vereinbarungen nicht immer gewährleisten, dass die Kunden jederzeit mit allen Netzen verbunden sind. Die im TKG 2003 vorgesehene Streitbeilegung erscheint im Hinblick auf den damit verbundenen Zeitaufwand nicht geeignet, die durchgehende Aufrechterhaltung des Zugangs zu gewährleisten“ (quoted in TKK, Bescheid M 1.11/2012-51, 14.07.2014,p. 36). The full judgment is available at: https://www.ris.bka.gv.at/Dokument.wxe?Abfrage=Vwgh&Dokumentnummer=JWT_2010030136_20130227X00.

462 See Decision of 13.6.2013, concerning Case AT/2013/1457: Call termination on individual public telephone networks provided at fixed location in Austria, C(2013) 3815, p.3.

463 Decision of 12.03.2010 on Case AT/2010/1046 – Wholesale call origination on the public telephone network provided at a fixed location, C(2010)1738, p.6.

between Orange and Free/Free Mobile by requiring the latter to include in its interconnection agreement with the former, the possibility to interconnect without tariff increase, under the IPv4 protocol in addition to the foreseen IPv6 interconnection as well as the inclusion of other technical features.[464]

In the UK there is a precedent of a dispute resolution based on authorization obligations: in 2010 the NRA settled a dispute between British Telecommunications Plc, and four mobile network operators about the termination charges which BT was entitled to charge to mobile network operators for putting calls from the latter's networks through to BT fixed lines with associated 08 numbers.[465]

This judgment is noteworthy in two aspects:

> **a) the double nature of the powers of NRA when settling disputes**: "Article 20.1 of the Framework Directive [now Article 26 EECC] requires national regulatory authorities to have power to resolve disputes (…) "in connection with obligations arising under this Directive or the Specific Directives between undertakings." Article 5.4 of the Access Directive [now Article 60(5)EECC] requires national regulatory authorities to have a power of intervention in a dispute about access and interconnection in accordance with (inter alia) the procedures in Article 20 of the Framework Directive, in order to secure the policy objectives of Article 8 of the Framework Directive [now Article 3(2)EECC]. The combined effect of these provisions is that the dispute resolution function extends to disputes of different kinds. A dispute may arise (i) under the existing interconnection terms, or (ii) because the parties have been unable to agree terms and one of them wants the regulator to impose them, or (iii) because there are binding terms but they do not satisfy (or no longer satisfy) Article 5.3 of the Access Directive or the policy objectives in Article 8 of the Framework Directive. In case (ii) it may perform an adjudicatory or a regulatory role or a combination of the two." [466] In both other cases, the NRA will perform a regulatory role.

> **b) criteria that NRAs may use to settle disputes:** the Court considered the NRA approach to apply a welfare test (assessing whether the disputed conditions provide benefits to consumers) and a competition test (assessing whether the disputed conditions do not entail a material distortion of competition) as well as a practicality test (assessing whether the implementation of the disputed conditions would be reasonably practicable) in addition to cost recovery considerations, to be reasonable.[467] At the same time, welfare and competition test should only override the other criteria, when they can be

464 ARCEP (2019)

465 The NRA decision was appealed up to the Supreme Court: British Telecommunications Plc (Appellant) v Telefónica O2 UK Ltd and Others (2014) UKSC 42. Available on: www.bailii.org/uk/cases/UKSC/2014/42.html

466 [2014] UKSC 42, o.c., par.32

467 « No one has challenged this as an appropriate analytical framework" (idem, par.20) and "(…) the fact that BT does not have significant market power in a relevant market does not mean that the promotion of competition, which is included among the Article 8 objectives, is irrelevant to a dispute about charges." (par.48).

clearly and distinctly demonstrated, i.e. that the disputed provisions are inconsistent with the objectives of (now) Article 3(2) EECC.

However, dispute resolution may be less effective in Member States with a large number of operators (e.g. Germany with more than 100 operators). This could lead to several hundreds of interconnection disputes, workload that even well-staffed NRAs which could not process in a reasonable time period. In such circumstances, an NRA would have reasons to conclude that, despite the availability of symmetric interconnection obligations and dispute resolution procedures, the interconnection market(s) are not likely to tend to effective competition, because of the manpower required to implement these tools in a timely manner. The NRA concerned could then notify interconnection markets in order to continue imposing, ex ante, detailed RIOs on the fixed incumbents and MNOs, which would otherwise have the ability and incentive to delay, discriminate or refuse to provide certain interconnection services.

6.3.4 Obligations of transparency (Art.69 EECC)

6.3.4.1 Obligations imposed

In all Member States, NRAs impose transparency obligations on fixed and mobile operators. However, the extent of these obligations vary. The publication of a reference interconnection offer is generally only imposed on the fixed incumbent operator and the (main)[468] mobile network operators, sometimes only on the incumbent fixed operator.[469] Other operators are only obliged to publish a minimum offer of conditions for interconnection,[470] including and interface descriptions[471] or even only the wholesale termination fees for incoming calls to their respective networks.[472] In Lithuania and in the UK, fixed alternative operators and

468 E.g. the Belgian NRA imposes the publication of a RIO only on the three mobile network operators (Decision of 21.4.2017 in Case BE/2017/1973: wholesale voice call termination on individual mobile networks C(2017) 2829, p.4), in Romania, Lycamobile is exempted(Decision of 11.12.2018 concerning Case RO/2018/2129: Wholesale call termination on individual public telephone networks provided at a fixed location and wholesale voice call termination on individual mobile networks, C(2018) 8810, p. 3) whereas in Sweden "Nettet, Lycamobile, TDC, Mundio and Götalandsnätet are [only] subject to an obligation to make public all the information necessary for entering into an interconnection agreement" (Decision of 20.07.2016 concerning Case SE/2016/1877: market for wholesale voice calls termination on individual mobile networks, C(2016) 4902, p.3).

469 E.g. in Bulgaria: Decision 26.5.2016 in Cases Case BG/2016/1862: Wholesale call termination on individual public telephone networks provided at a fixed location, p.5.

470 E.g. Decision of 12.2.2019 in Cases HR/2019/2139: Wholesale call termination on individual public telephone networks provided at a fixed location. In France, operators that have less than 1 million active clients must publish a simplified RIO (Case FR/2017/2029: Market for wholesale call termination on individual mobile networks, C(2017) 8078, p.3-4). In Germany, alternative fixed operators and MVNOs MVNOs must only publish the information that is necessary to address demands (Decision of 14.12.2016 concerning Cases DE/2016/1945-1946: Market for wholesale call termination in individual public telephone networks provided at a fixed location, C(2016) 8814, p.6 and decision of 29.7.2016 in Case DE/2016/1887: Wholesale markets for voice call termination on individual mobile networks, C(2016) 5072, p. 3).

471 E.g. Decision of 26/11/2007 in Case FI/2007/0704: Call termination on individual public telephone networks provided at a fixed location, SG-Greffe (2007) D/207180, p.5

472 E.g. Decision of 31.7.2015 in Case CY/2015/1756: wholesale call termination on individual public telephone networks provided at a fixed location in Cyprus, C(2015) 5563, p.3

MVNOs are not subject to transparency (and non-discrimination) obligations.[473] In Denmark, Portugal [474]and Poland only the fixed incumbent must publish a RIO.

A similar differentiation exists as regards the obligation to publish KPIs.[475]

Obligations of transparency include in some Member States obligations to submit to the NRA all agreements on access services and facilities to which they are parties as providers.[476]

6.3.4.2 Alternatives to SMP regulation

Obligations of transparency are ancillary to other obligations, either to access obligations – without transparency, access negotiations are difficult to prepare –, non-discrimination obligations or pricing obligations.

The first category of transparency obligations – including the publication of access conditions – can be included with the access obligations discussed in previous section. Point 9 of Part A of Annex I allows indeed Member States to include in the general authorization, transparency obligations on providers of public electronic communications network to ensure end-to-end connectivity and, where necessary and proportionate, access by competent authorities to such information needed to verify the accuracy of such disclosure.

Where the publication of price lists, interconnection points etc. necessary to ensure end-to-end connectivity could be required under the general authorization, more specific obligations such as the publication of detailed RIOs, would require individual decisions from NRAs, public consultation and notification to the Commission and other NRAs in case the measure could affect trade. Given that the aim of RIOs is to facilitate the negotiation of interconnection agreements, such transparency obligations fall within the ambit of Art.61(1) and (6) EECC.

473 See Decisions of 4.6.2019 concerning Case LT/2019/2162: Wholesale call termination on individual public telephone networks provided at a fixed location, C(2019) 4276, p. 4 and of 16.12.2015 concerning Case LT/2015/1822: Wholesale voice call termination on individual mobile networks, C(2015)9666, p. 2-3. In the UK, no mobile operator is subject to the publication of a reference interconnection offer (Decision of 22.3.2018 concerning Case UK/2018/2061: market for wholesale voice call termination on individual mobile networks, C(2018) 1930, p.3).

474 According to the NRA, “the RIO facilitates the negotiation of interconnection agreements with MEO (which is the only operator with a hierarchical network structure), thereby reducing barriers to entry, and will also contribute to streamline the migration to MEO’s IP network through the publication of clear technical conditions for IP interconnection” (Decision of 6.6.2018 concerning Case PT/2018/2076: wholesale voice call termination on individual mobile networks, C(2018) 3740, p. 3).

475 E.g. Decision of 5.5.2017 in Case DK/2017/1974: Call termination on individual public telephone networks provided at a fixed location, C(2017) 3170, p. 3 or Decision of 31.8.2018 concerning Case PT/2018/2101: Wholesale voice call termination on individual public telephone networks provided at a fixed location, C(2018) 5876, p. 4.

476 E.g. in Germany and in Luxembourg, where mobile operators must notify the NRA access and interconnection agreements with other operators within 30 days from entry into force as well as the technical, operational and tariff details as provided to access seekers (Decision of 29.11.2013 concerning i.a. Case LU/2013/1522: Call termination on individual mobile networks C(2013)8710, p.3).

In order to monitor compliance with the Eurorates fixed under Art.75 EECC, transparency obligations will need to be imposed on all operators terminating traffic on their networks or to their own end-users.[477] Art.20(1) provides a sufficient legal basis for that purpose ("Member States shall ensure that undertakings providing electronic communications networks and services, associated facilities, or associated services, provide all the information, including financial information, necessary for national regulatory authorities, other competent authorities and BEREC to ensure conformity with the provisions of, or decisions or opinions adopted in accordance with, this Directive"). Given that the information requirement will apply to all network operators, the obligation could be included in the general authorisation as part of the transparency obligations to ensure end-to-end connectivity.

6.3.5 Obligations of non-discrimination (Art.70 EECC)

6.3.5.1 Obligations imposed

All but three NRAs impose non-discrimination obligations on all operators. In the UK, non-discrimination is only imposed on the incumbents in the fixed termination market, while in the Lithuania and Latvia, the MNOs remain subject to a non-discrimination obligation. The Latvian NRA warned that "the obligations of non-discrimination may restrict alternative network operator's ability to use innovative pricing mechanisms such as "bill and keep" in the future".[478]

There are nevertheless gradations as to the extent of the non-discrimination obligation. Generally the obligation means that the operator is required to charge the same termination rate to operators buying the same service.[479] However, some NRAs impose also internal non-discrimination obligations and Equality of Output[480] or Input.

477 The UK NRA acknowledged that the transparency obligations imposed previously "has not been effective in facilitating the monitoring of compliance with the regulation of MTRs set on the basis of the model. Ofcom therefore proposes to introduce for all SMP operators, as a complement to the price control obligation, a requirement to notify the regulator on an annual basis of the MTR applied in the previous year" (Decision of 22.3.2018 concerning Case UK/2018/2061: market for wholesale voice call termination on individual mobile networks, C(2018) 1930, p.3).

478 Decision of 30.3.2017 concerning Case LV/2017/1967: Wholesale call termination on individual public telephone networks provided at a fixed location and Case LV/2017/1968: Wholesale voice call termination on individual mobile networks, C(2017) 2248, p. 3.

479 E.g. in Slovenia, the non-discrimination obligation consists in requiring SMP operators to apply the same conditions and prices for the same services towards all operators from the EEA, regardless of whether they are fixed, mobile or transit operators (including international traffic regardless of its origin (Decision of 20.6.2014 concerning Case SI/2014/1610: Voice call termination on individual mobile networks, C(2014) 4305, p.4).

480 E.g. Austria, France and Germany as regards both the fixed incumbent and mobile operators, Belgium as regards fixed operators (regarding QoS,)

6.3.5.2 Alternatives to SMP regulation

Contrary to access and transparency obligations, non-discrimination obligations relating to non-pricing aspects (which could fall under a symmetric ‘fairness’ licensing obligation) would be less easy to impose as symmetric remedy under Art.61(1) and (6) EECC. It would seem that, before imposing such obligation, the NRA would have to show that discrimination as such (and not the significance of the discrimination) hampers end-to-end connectivity. Prohibiting any discrimination, and in particular self-preference, as part of general authorisations would not seem possible, as discrimination is necessary to allow innovation, as the Latvian NRA rightly emphasizes.[481] However, non-discrimination obligations could be imposed by NRAs in the framework of dispute resolution, where the discriminations concerned would be susceptible to affect the effectiveness of end-to-end connectivity. The threshold to impose such obligation would likely be similar to that applied under EU competition law, i.e. to “be based on an analysis of all the relevant circumstances of the case leading to the conclusion that that behaviour has an effect on the costs, profits or any other relevant interest of one or more of those partners, so that that conduct is such as to affect that situation”.[482]

One contribution to the targeted public consultation on the Review of the Recommendation on Relevant Markets,[483] provides two specific illustration of discrimination in absence of a specific, ex ante non-discrimination obligation. First, wholesale SMS termination, “where extremely excessive and discriminatory (e.g. volume-based tariff differentiation and operator type-based tariff differentiation) wholesale charges are applied. The BEREC data gathering also shows that wholesale SMS termination rates basically vary by a factor 10 between EU Member States, with clearly unjustifiable levels in many EU Member States.”[484] Second, the “one-off and recurring charges for voice interconnection ports (e.g. in Italy, port charges were 23x the EU average before being subject to specific ex-ante assessment).”[485] Both illustrations in fact plead for the removal of the call termination markets from the recommendation. Indeed, the reason why NRAs cannot impose SMP remedies as regards SMS termination is because the SMS termination markets do no longer fulfil the three criteria test.[486] Given that no SMP must be shown to act under Art.61(1) and (6) EECC, NRAs could have dealt with the matter on a case by case basis, where the alleged discrimination had a detrimental effect on adequate access and interconnection, and the interoperability of services. The same holds true for the mentioned excessive charges for interconnection ports, hindering the achievement of the policy objectives of Art.3 EECC.

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481 SPRK explains that the obligations of non-discrimination may restrict ANOs' ability to use innovative pricing”mechanisms such as "bill and keep" in the future.” case LV/2014/1625, decision C(2014) 5159 final of 15.7.2014, p.3

482 Case C-525/16, MEO — Serviços de Comunicações e Multimédia SA (2018) EU:C:2018:270

483 WIK-Consult, Summary EC consultation, p.6.

484 MVNO Europe – Response on Recommendation Relevant Markets – 10 May 2019, p. 7.

485 Idem, p.8.

486 For further details see in particular Decision of 28.11.2014 Case FR/2014/1670: Wholesale SMS termination on individual mobile networks, C(2014) 9270.

6.3.6 Obligation of accounting separation (Art.71 EECC)

6.3.6.1 Obligations imposed

Accounting separation allows internal price transfers to be rendered visible, and allows national regulatory authorities to check compliance with obligations for non-discrimination where applicable.[487] It is not a self-standing remedy. “NRAs that have established prices through BU-LRIC models have in some cases removed the Accounting Separation obligation“.[488] Today, no accounting separation is imposed in Germany, Denmark, Finland, Ireland, Luxembourg, Malta,[489] the Netherlands, Portugal, Romania, Slovakia, Lithuania and Estonia. In most of the other Member States, accounting separation is also imposed on the largest mobile operators but never on fixed alternative operators.

6.3.6.2 Alternatives to SMP regulation

Accounting separation could not be included as an obligation in general authorisations. Art.61(1) and (6) EECC does also not seem to provide a solid legal basis for such obligation.

The question is nonetheless whether there will still be a need for accounting separation, now that NRAs will be relieved of the regulatory burden[490] to establish costing methodologies to set termination charges.

6.3.7 Price control and cost accounting obligations (Art.74 EECC)

6.3.7.1 Obligations imposed

To date, price controls are imposed in all Member States,[491] but not cost accounting obligations. The NRAs in Austria, Czech Republic, Denmark, Germany, Hungary, Ireland, Luxembourg, the Netherlands, Portugal, Romania, Slovakia, Lithuania and Estonia do not

487 Recital 186 EECC. “Ces obligations comptables sont un moyen pour l’Autorité de vérifier, d’une part, la mise en œuvre de l’obligation de non-discrimination et, d’autre part, de disposer d’une connaissance fine et fiable des coûts des opérateurs afin de contrôler le respect des obligations tarifaires et de mettre en œuvre, le cas échéant, un encadrement tarifaire reflétant les coûts pertinents » ARCEP, Décision n° 2017-1453 de l’Autorité de régulation des communications électroniques et des postes en date du 12 décembre 2017 portant sur la détermination des marchés pertinents relatifs à la terminaison d’appel vocal sur les réseaux fixes en France et à la terminaison d’appel vocal sur les réseaux mobiles en France, la désignation d'opérateurs exerçant une influence significative sur ces marchés et les obligations imposées à ce titre pour la période 2017-2020, p.38.

488 BEREC (2017b, p.12).

489 The NRA “considers that, in view of the efficient regulated wholesale FTR currently in force, coupled with the transparency and non-discrimination obligation, it would not be proportionate to continue to impose the accounting-separation obligation on GO and Melita indefinitely” (Decision of 30.11.2015 concerning Case MT/2015/1796: Wholesale call termination on individual public telephone networks provided at a fixed location, C(2015) 8661, p. 3).

490 Recital 196 EECC.

491 See Figure 12 in BEREC (2018d, p.19).

impose specific cost accounting obligations. In the other Member States, the NRA imposes lighter or even no[492] cost accounting obligations on fixed alternative network operators and smaller mobile players. Where termination rates are regulated in line with the Commission Recommendation 2009/396/EC and a bottom up approach is used[493], NRAs found it less relevant imposing regulatory cost accounting methodologies. In a bottom-up approach the cost of each service is computed from an engineering model of the most efficient facility specialized in the production of that service. The accounting systems of the regulated provider are not required to allocate costs to services as it is the case in top-down models.

6.3.7.2 Alternatives to SMP regulation

Once the Eurorates will enter into force, it would appear that imposing accounting methodologies on operators would be disproportionate. The question of alternatives to the current SMP regulation is therefore not relevant.

492 E.g. in France, cost accounting obligations are imposed only on six mobile operators (Bouygues Telecom, Free Mobile, Orange, SFR, Orange Caraibe and SRR) and on one fixed operator (Orange), while in Finland, Ålands Telekommunikation Ab is exempted.

493 23 NRAs apply a pure BULRIC costing/benchmarking approach in their price controls for call termination (see: BEREC 2019c, p.12 and 22).

7 Evaluation of options

In this chapter, we describe and then assess the costs and benefits of the different options for the reform of the Recommendation on Relevant Markets, with reference to the objectives outlined in the EU Electronic Communications Code, and impact assessment practices outlined in the Commission's Better Regulation Guidelines.[494]

7.1 Approach

The Recommendation on Relevant Markets seeks to ensure that enduring bottlenecks to competition in electronic communications markets are appropriately addressed through ex ante regulation.

In addition to supporting the promotion of competition, which is a key objective of the Code, addressing these bottlenecks should also facilitate the deployment and take-up of very high capacity broadband, protect consumer interests, and support coherent solutions to common problems, thereby facilitating cross-border entry and the delivery of cross-border services.

In the following sections, we outline the options for each of the markets identified in the report. In all cases we consider the impact of the removal of the market from the list of markets susceptible to ex ante regulation, alongside maintaining relevant markets within the list in a manner which would minimise regulatory intervention as described in the relevant chapters of the report. In the case of wholesale broadband and dedicated access markets, we also consider options which would involve widening the scope of relevant markets, and therefore potentially increasing the scope for regulation, recommended in the context of the relevant market recommendation.

We consider both administrative impacts (cost savings or additional costs) and substantive impacts, affecting the deployment and take-up of VHC, competition, consumer welfare and the single market.

Evidence for the administrative impacts comes from data gathering and interviews with selected NRAs and stakeholders during March 2020.

Evidence for substantive impacts is drawn from:

- Data gathered from NRAs in the context of this report
- Interviews conducted with operators and feedback received in the context of the 6 March 2020 stakeholder workshop;
- Relevant literature; and

494 The Commission Better Regulation Guidelines are available at https://ec.europa.eu/info/sites/info/files/better-regulation-guidelines-impact-assessment.pdf.

- Theoretical models

The results are presented in a table enabling the ready comparisons of the impact of the different options on the objectives set out in the Code.

7.2 Physical infrastructure access

7.2.1 Relevant options

7.2.1.1 Option 1: Separate physical infrastructure access (PIA) market

Under this option, it is assumed that a separate market for physical infrastructure access would be identified as a relevant market susceptible to ex ante SMP regulation. This market would lie upstream from the currently defined markets for WLA (market 3a), WCA (market 3b) and HQA (market 4).

7.2.1.2 Option 2: PIA market not listed in the list of relevant markets susceptible to ex ante regulation, but other options remain available

Under this option, it is assumed that there would be no separate market for PIA in the Recommendation on Relevant Markets. However, other options would remain available for the regulation of PIA.

One option (option 2a) would be article 72 of the Code which allows NRAs to impose PIA access as an SMP obligation, irrespective of whether the assets are part of the relevant market, provided that the obligation is necessary and proportionate to meet the objectives set out in Article 3 of the Code. If there is evidence of a pricing constraint between PIA and downstream wholesale local access, NRAs could also, as practised in France[495] and Spain, find that PIA substitutes for other wholesale products within the WLA market and include it within the scope of the market definition.

Another option available for the regulation of ducts and poles and associated facilities (option 2b) would be to rely on article 3 of the 2014 Broadband Cost Reduction Directive,[496] which requires member states to ensure that, all network operators (including telecom operators) have an obligation to meet reasonable requests for access to PIA under fair and reasonable terms and conditions, including price. Under this option, strengthened enforcement of the BB CRD could be envisaged.

495 Based on the market analysis in force, In February 2020, ARCEP released a consultation in which it proposes to define PIA as a separate market.
496 European Parliament (2014).

7.2.2 Impact assessment

7.2.2.1 Regulatory implications

Separate PIA market

The practical implication of including a specific market for PIA in the Relevant Market Recommendation is that all NRAs would be obliged to conduct a review of this market, at least on one occasion and potentially on an ongoing basis (if the 3 criteria test are found to be fulfilled at a national level). This obligation would apply even in cases where PIA is not relevant e.g. where ducts and poles are not widespread.

This presumes that NRAs would need to gather data on the location and accessibility of telecom ducts and poles across their national geography, and potentially (although it is not considered a direct substitute) data on the location and accessibility of utility ducts and poles. The detail required and accuracy expected would likely be greater than in the case where NRAs impose PIA as a remedy in the context of another relevant market.

Some NRAs may already have required detailed information to be collected and made available concerning the location and availability of ducts of the SMP operator, and potentially also those which could be provided by utilities. Mapping of ducts and poles could be conducted in conjunction with the requirement in article 22 of the Code to conduct a geographical survey of the current geographic reach of broadband network, but is not specifically required. Likewise, the introduction of comprehensive maps of duct and pole infrastructure (for all network operators) could be foreseen in the context of article 4 of the BB CRD, although it is not required.

NRAs requiring detailed mapping of SMP PIA are generally those which consider that PIA is a relevant and significant wholesale access product and have already mandated PIA as a remedy in the context of another relevant market. Some of these NRAs – notably ARCEP and Ofcom – have concluded that PIA forms a separate relevant market.

If PIA is identified as a separate market, it would reinforce the principle, established in article 73 of the Code, that before mandating other access obligations, NRAs should examine whether the imposition of PIA alone would be a proportionate means by which to promote competition and end-users‘ interests. Moreover, identifying a separate PIA market would be consistent with establishing PIA as the sole remedy, since it would not be logical to find that one or more operators have SMP in a market which is downstream from PIA, if SMP in that market could satisfactorily be addressed through PIA alone.[497]

497 This was one of the arguments given by Ofcom to justify the identification of a separate PIA market in its 2019 market analysis. See Ofcom (2019b).

For the reasons given in section 5.2.4, it is likely that a separate PIA market would be found to be national, in all countries where the incumbent has the most extensive duct and pole network which is suitable for telecoms. The presence of ducted cable infrastructure in part of the country was not considered in either France or the UK to represent a sufficient difference in competitive dynamic to warrant geographic segmentation of this market. The fact that the incumbent engages in wholesaling and has already granted access to PIA is likely to further present a significant impediment to switching and support the finding of a national market. In countries where there is no operator with a more extensive duct and pole network than others, there may conversely be a case to handle PIA regulation through other means such as the BB CRD.

Identifying a separate market for PIA may prompt further NRAs to make SMP PIA operational than those which have done so to date. This may require more detailed information to be made available than was previously the case as well as entailing a greater focus on the specification and costing of this wholesale product.

The identification of PIA as a separate market may have implications for the definition of downstream markets. In particular, excluding PIA from the scope of the WLA market, especially when combined with a potential migration away from copper, may mean that the focus of the WLA market shifts over time towards VHC access alone. In turn, the exclusion of a nationwide constraint from an incumbent’s ubiquitous copper infrastructure increases the likelihood that NRAs may find different geographic conditions for competition at the level of the market definition, and consequently segment the market rather than finding a national market for WLA and potentially segmenting remedies for VHC, as is the case today. Depending on market dynamics in different countries, this could result in some areas being fully deregulated and/or in regional operators being found to have SMP in cases where they have a significant regional wholesale market share. These questions are already being considered in countries such as Sweden and Denmark.

<u>PIA as a remedy or within the scope of the WLA market definition</u>

Most NRAs today which have imposed a PIA obligation, do so as a remedy associated with the WLA market, or in a few cases include it within the scope of the market definition. This approach would thus constitute a continuation of the status quo. In nearly all cases today, the WLA market has been found to be national, and thus PIA has been imposed on a nationwide basis, and is often used in the most densely populated areas. However, as competition begins to emerge in the context of VHC networks, NRAs may be prompted to assess whether the WLA market is still national. If they conclude that it is no longer national, it may no longer be possible to rely on article 72 of the Code (PIA as a remedy) to ensure that PIA is mandated nationwide.

NRAs could seek to address this challenge by investigating whether PIA falls within the scope of the WLA market definition. Where this is the case, if the incumbent maintains control over a ubiquitous duct (and where relevant copper) infrastructure, it is possible that this could result in a nationwide market definition and associated nationwide PIA remedies.

Some deregulation of wholesale access to VHC networks could occur in this scenario, but may not be complete, and would be on the basis of variations in remedies. It is likely in the event of nationwide WLA markets, including (or taking into account) PIA that the incumbent would be found to have SMP, while regional operators would likely not have an SMP designation even if they have a high market share in their local access, due to their low share of the national market.

Reliance on the BB CRD

NRAs could make use of symmetric regulation for PIA as an alternative to mandating PIA via remedies or through inclusion of PIA within a wider market for WLA. However, achieving an equivalent regulation of PIA via symmetric regulation (BB CRD) would require stringent and proactive application of access obligations, which goes beyond those required in article 3 of the BB CRD.[498] Such obligations would normally apply on all operators, except those able to reject the request for access on „objective, transparent and proportionate“ criteria (including due to lack of space or the availability of alternative wholesale physical network infrastructure access on fair and reasonable terms). NRAs would also need to take into account the effect of offering access on the business case of the operators affected by the obligation, which may mean that the price of wholesale access may not be cost-oriented.

7.2.2.2 Administrative costs

From an administrative perspective, defining a separate PIA market would require NRAs to gather relevant data and carry out a market review on PIA, potentially in place of mandating PIA as a remedy within a market analysis of the WLA market or including PIA within the WLA market.

As this is not the current practice in most countries today, few NRAs were able to estimate the time taken for such an approach, based on practical experience. Those few that responded to the question were split between those that considered that the time taken to review this market would be comparable to or less than other markets (below 150 days) and those that considered that it would take more than 1000 man days. Several NRAs highlighted that collecting data about the location and suitability of ducts, geographic analyses and analyses around potential substitution with utility ducts, would be particularly time consuming. Some NRAs which have PIA access in place via remedies, observed that more complex analysis would be required to achieve the same result, and most of those responding estimated that applying PIA as a remedy through another market (such as WLA) would take considerably less time than analysing it as a market in its own right (a median of 60 man days and average of 77). Other NRAs which do not currently mandate SMP PIA regulation (due to the absence of ducts and poles or use of alternative symmetric remedies)

498 Examples might be ex ante obligations rather than obligations based on reasonable request, and the requirement for reference offers and establishing pricing.

did not indicate what a requirement to conduct at least one PIA market review would imply in terms of resources. However, it can be assumed that more resources would be required than under the status quo.

When asked what resources would be required to intensify symmetric PIA (under the BB CRD) as an alternative to SMP PIA regulation, a number of NRAs observed that they did not consider that symmetric regulation would be appropriate for this remedy, because PIA required detailed elaboration and enforcement, and/or because it was better suited to an overall Decision rather than dispute resolution between individual parties. In one case the NRA noted that it lacked the power to enforce the BB CRD. A number of NRAs with experience of the existing application of dispute resolution under the BB CRD (operating alongside SMP regulation) noted that the resourcing required was high and assumed to be as high or considerably higher than applying an SMP-based approach to PIA regulation. The time spent on application of PIA remedies via symmetric regulation (dispute resolution) approached or exceeded 500 man days per year in some cases. Other NRAs however estimated that a much lower amount of time would be needed in this scenario.

Four operators, including an incumbent, alternative operator, regional fibre investor, and business specialist, provided input on the administrative costs associated with market analysis. Respondents generally observed that implementing PIA via a separate market would require more resources than implementing it as a remedy under the WLA market. However, one respondent observed that the resource might decline in subsequent reviews after an initial „set-up“ cost, and another noted that some required aspects of the analysis (duct mapping) were already undertaken in a different context (urban planning). On the other hand, intensifying symmetric PIA regulation as an alternative to SMP regulation was considered to incur even more effort, due to extension in the scope of regulation (to others than the SMP operator) as well as the dispute driven nature of the process.

7.2.2.3 Implications for stakeholders

Incumbents

The identification of a separate PIA market is likely to have no effect on operators which have already been found to have SMP in the WLA market and have had SMP PIA remedies mandated in that context. It may result in more attention being given to enforcing the PIA remedy on incumbents in countries where incumbent ducts are widespread, but PIA has not been mandated or fully implemented. Incumbents may also be affected by the downstream implications of excluding PIA from the scope of consideration of the WLA market. Removing PIA from its scope (and over time – copper-based infrastructure) may in particular place additional focus by NRAs on the conditions of competition in VHC networks. This may be to the advantage of incumbents as it could potentially result in SMP designations being lifted in certain areas and/or finding that operators other than the traditional incumbent may have SMP in certain areas.

Cable operators

If found to be national in scale, a separate PIA market is unlikely to have a material impact on cable operators, except in so far as it may stimulate additional infrastructure competition in areas where cable operators are present.

Where a PIA market is found to be subnational or national in cases where the footprint matches that of the cable operator, there is a risk of a joint SMP finding. On the other hand, in this situation, there is also the potential for a „no SMP“ finding or a finding that pre-existing installation and switching barriers prevent the inclusion of cable ducts and poles alongside those of the incumbent, which would be neutral or positive for cable operators. NRAs could also in that situation conclude that the provisions of the BB CRD are sufficient to address PIA requirements.

Regional investors

Alternative investors with their own duct infrastructure, such as cable operators and some municipal operators or utility providers offering telecom services, are unlikely to be materially impacted by the definition of a separate PIA market in the event that the PIA market is found to be national (or addressed through the BB CRD in the event that it is more fragmented). The only effect may be additional infrastructure competition in mass-market broadband and/or a greater degree of self-deployment of mobile backhaul and business connectivity that may arise in countries where increased focus on PIA results in increased enforcement of this remedy on the SMP operator. This is however, a general consequence of policies which favour infrastructure competition via duct and pole access, in line with principles established in the EU electronic communications Code.[499]

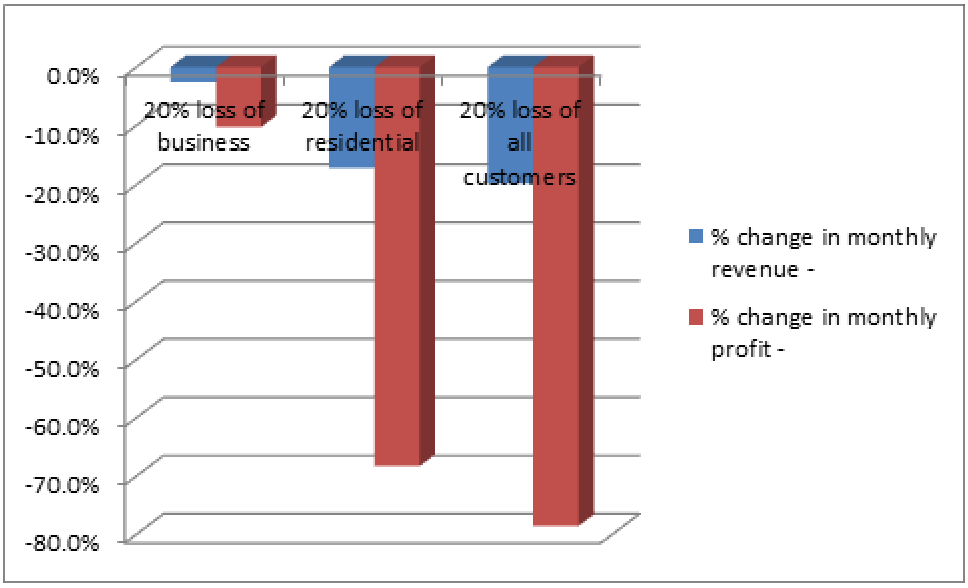
Based on WIK-Consult business models, we have estimated the effect on revenues and profits of increased infrastructure competition on a regional fibre operator with its own duct infrastructure. Key assumptions are that:

- The regional fibre operator rolls out in a region and achieves 80% market share of all residential and business customers in that region
- The proportion of residential versus business customers is 93/7%
- Residential ARPU is on average €45 with €95 for business customers (mainly SMEs). Only 0.5% of the lines are leased lines to large business sites. The cost for these connections is significantly higher than that for SMEs, but the inputs and value added services are also more costly than the products offered to SMEs.
- Modelling based on a 40 year business case for deploying a fibre network

499 Article 73 of the Code in particular highlights the presumption that PIA should be considered ahead of other potential remedies.

The impact on the revenues and profit margins of infrastructure competition on such an operator are illustrated under three scenarios (i) loss of 20% of its business customers; (ii) loss of 20% of its residential customers; and (iii) 20% loss on all customers. If the business is conducted in a region which cannot support more than 1 fibre infrastructure, the most likely scenario might be targeted competition on the more valuable business segment, leading to reduced revenues of around 2.5% and reduced profit margins of around 10%. Such reduced profit levels could be sustainable and reflect competitive pressure, or if they are seen to be unsustainable, the regional provider might seek to counter the loss of revenues through making attractive wholesale access offers.

Figure 7-1: Impact on revenues and profit of infrastructure competition on a regional fibre operator with 80% market share under 3 scenarios



Source: WIK-Consult based on theoretical business modelling

Alternative fibre investors, specialist business providers and mobile operators without their own duct infrastructure may benefit from increased attention to and stronger enforcement of PIA, which may enable them to expand their fixed and mobile network reach.

Alternative investors of all kinds (including cable operators, municipal and utility operators and alternative operators climbing the ladder of investment) may be affected by the potential downstream implications of excluding PIA (and in time copper) from the scope of consideration of the WLA market, which as discussed above increases the prospect that some areas may be found to be effectively competitive, while in others, non-incumbents, including potentially regional operators themselves, may be found to have SMP.

Access seekers

The impact of a separate PIA market on access seekers depends on the demand for PIA by those access seekers and consequences for the market analysis and associated regulation.

In countries where there is a widespread ubiquitous incumbent PIA network, and significant demand from access seekers for PIA, a separate PIA market could help to secure the availability of PIA on a nationwide basis. Equally however, if such a market results in deregulation in the downstream WLA and dedicated access markets, access seekers requiring access to unbundled fibre, VULA and/or dedicated access may be negatively affected, unless attractive commercial offers are available in the absence of regulation.

7.2.2.4 Impact on VHC deployment, competition and consequent consumer welfare

The different options under consideration may affect the degree of attention given to and effectiveness of the PIA remedy in given circumstances. The options as well as the potential to impose obligations on PIA in a manner which is independent from analysis of and potential obligations on downstream markets. In turn, the availability and degree of effectiveness of the PIA remedy may have an impact on VHC deployment, competition and consumer welfare.

Impact of different options on availability and effectiveness of PIA

A separate PIA market places the greatest focus on PIA as a remedy for the promotion of competition in VHC. In countries where there is a single widespread PIA network which is or could be used to deploy VHC and dedicated access, this mechanism is likely to be the most effective in ensuring the long-term availability on a nationwide basis of the PIA remedy, including in circumstances where downstream markets may be deregulated or a different (regional or national) provider than the incumbent may be found to have SMP.

Although it gives less focus to PIA explicitly, experience from countries such as Portugal shows that where NRAs actively operationalise the PIA remedy, mandating PIA as a remedy can be as effective as mandating it via the identification of a separate PIA market. This approach could be appropriate on an ongoing basis where SMP PIA is not the primary means by which infrastructure competition has developed or may develop or where it is only imposed to a limited extent if at all.[500] It is however not suitable in cases where broadband services and/or dedicated lines are or are likely to become competitive as a result of the PIA remedy, as it could risk the inappropriate deregulation of PIA in the areas where it has been used more intensively – risking the development of infrastructure-based competition.

The inclusion of PIA within the WLA market can also be associated with the effective implementation of PIA on a nationwide basis as can be seen in the French case. This approach may avoid the problem described above, if it results in WLA markets including PIA being defined as nationwide, and the imposition of a nationwide PIA remedy on that basis. However, by relying on segmentation of remedies for VHC, it could limit the degree to which

500 For example cases where the incumbent network is only partially ducted and/or where demand for PIA is limited because competitors rely on their own ducts or because wholesale access to VHC networks is widely available and preferred to PIA.

full deregulation may be possible in areas where infrastructure-based competition has developed or could develop, which could limit the commercial freedom of the designated SMP operator. This approach also assumes, and is therefore only suitable for, situations where the predominant provider of PIA and VHC services is the same organisation. However, this presumption may not hold in the long run if the PIA remedy is effective in permitting entry.

As regards the potential use of the BB CRD as an alternative to SMP regulation, data on the respective use of SMP and symmetric PIA points to the need to rely on SMP regulation as a primary tool for enforcement (see Figure 5-5). This was confirmed by responses gathered from NRAs concerning administrative cost (see section 7.2.2.2), which suggest that while it is useful in certain circumstances (and particularly in providing access to utility infrastructure, where relevant), symmetric regulation was not generally considered by NRAs, which had focused on operationalising PIA, to be an effective replacement for SMP PIA regulation. This was due to the need to fine-tune obligations, and ensure that telecoms PIA is cost-oriented (which may not be possible in the context of the BB CRD). Moreover, relying on symmetric regulation in cases where there is or could be widespread reliance on duct access, may imply widening enforcement of the obligation to all telecom operators, which may be disproportionate for those with a limited footprint and market power. For these reasons, SMP PIA is considered more likely to support the effective implementation of the PIA remedy than reliance on the BB CRD. PIA under the BB CRD may still however be important in certain cases e.g. where telecom PIA is limited or fragmented (requiring complementary solutions) and/or where there is the prospect to make significant use of utility PIA, as has been the case for certain rural deployments.

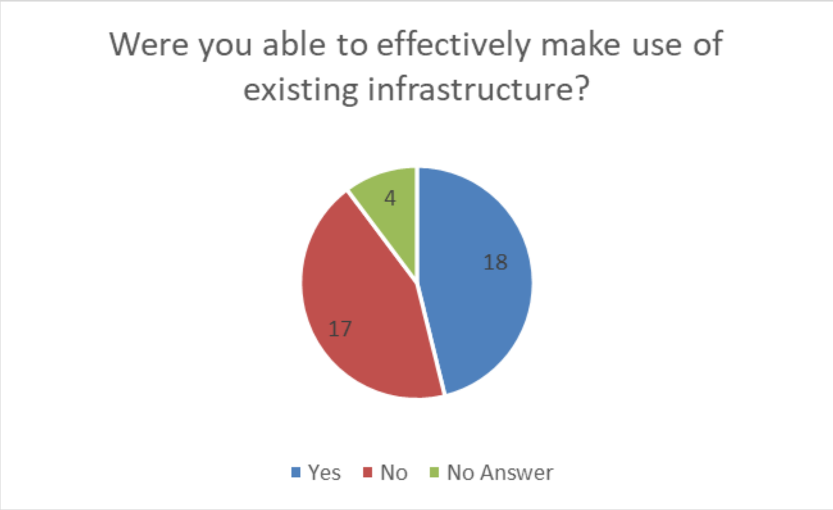
<u>Impact of effective PIA on VHC deployment, competition and end-user interests</u>

When effectively implemented, PIA can have a significant impact on VHC deployment, competition, and end-user interests. However, its effects are likely to be limited to specific circumstances and areas and it is not relevant in all cases.

An important impact can be to improve the potential for non-incumbent operators to bid for and be awarded contracts for the deployment of VHC in areas supported by state aid, where only one VHC network may be viable.

In this context, it should be noted that 46% of operators responding to a survey distributed by WIK and VVA in 2019 concerning challenges associated with the implementation of broadband state aid, stated that they were not able to effectively make use of existing infrastructure such as duct and poles, for the provision of broadband services in areas tendered for state aid (see below).

Figure 7-2: Stakeholder perspectives on availability of access to existing infrastructure in areas subject to state aid tenders



Source: WIK/VVA survey 2019 conducted in the context of a study for the EC on the Implementation of Broadband State Aid

Experience of deployment in countries which placed a high focus on PIA in the initial deployment phase of FTTH confirms that, where is can be made effective, PIA supports alternative operators in deploying FTTH infrastructure in areas supported by state aid.[501]

Effective SMP PIA can also contribute to the development of infrastructure-based competition in some areas. However the geographic scope of the areas that could support greater levels of mass-market VHC infrastructure competition through effective access to PIA are limited, and may range from 10% or less households as seen in France or illustrated in models and analyses of the German market prepared by WIK-Consult, [502] to more than 30% in cases where the conditions for PIA are the most favourable.[503]

The potential for duplication, where viable, is likely to be restricted to dense urban areas where the market share for profitability lies below 30% (e.g. clusters 1 and 2 in the following chart illustrating economics of replicability in Germany).[504]

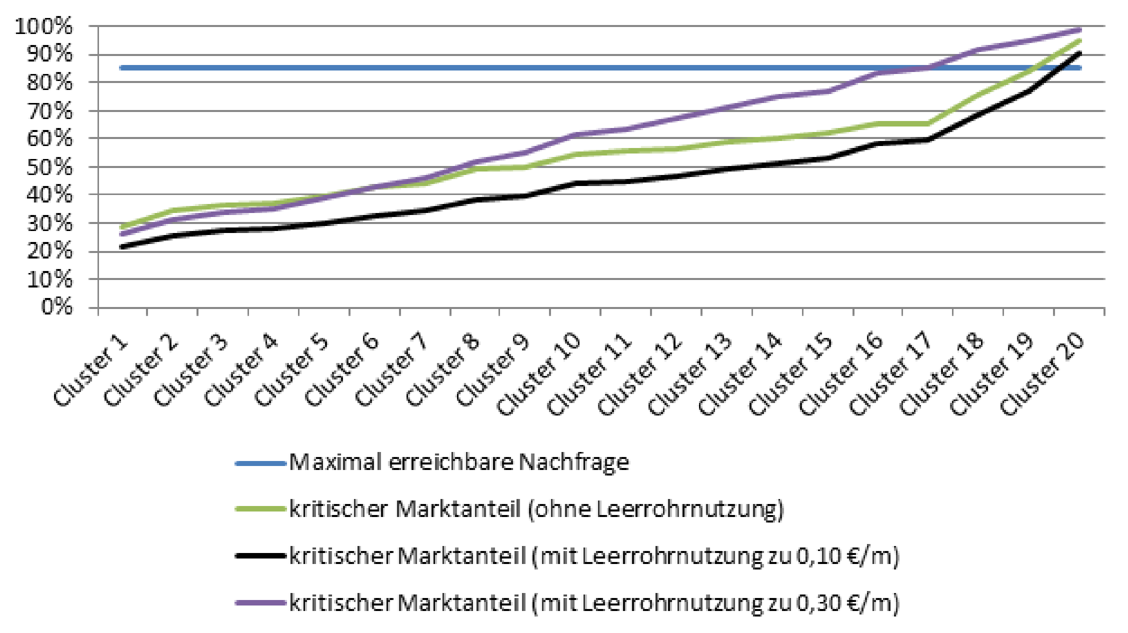
501 PIA from both the incumbent and utilities has been extensively used to support fibre deployment in the context of state aid in France, Spain and Portugal.

502 20% of the population could be served in an ideal case (where duct is 100% available in the feeder and drop segment). A maximum of 10% population could be services if PIA is only available in 40% of cases (Braun et al., 2019).

503 See scope of infrastructure competition in Portugal e.g. Table 3-2.

504 The chart illustrates the critical market share needed for viability for high (purple) and low (black) PIA charges, split by area type, where cluster 1 represents the most densely populated zones and cluster, the most remote. Results illustrate that some replication with PIA is possible in the denser clusters, but that the required shares quickly increase such that only a single fibre line could be supported.

Figure 7-3: Critical market share associated with high and low costs of PIA

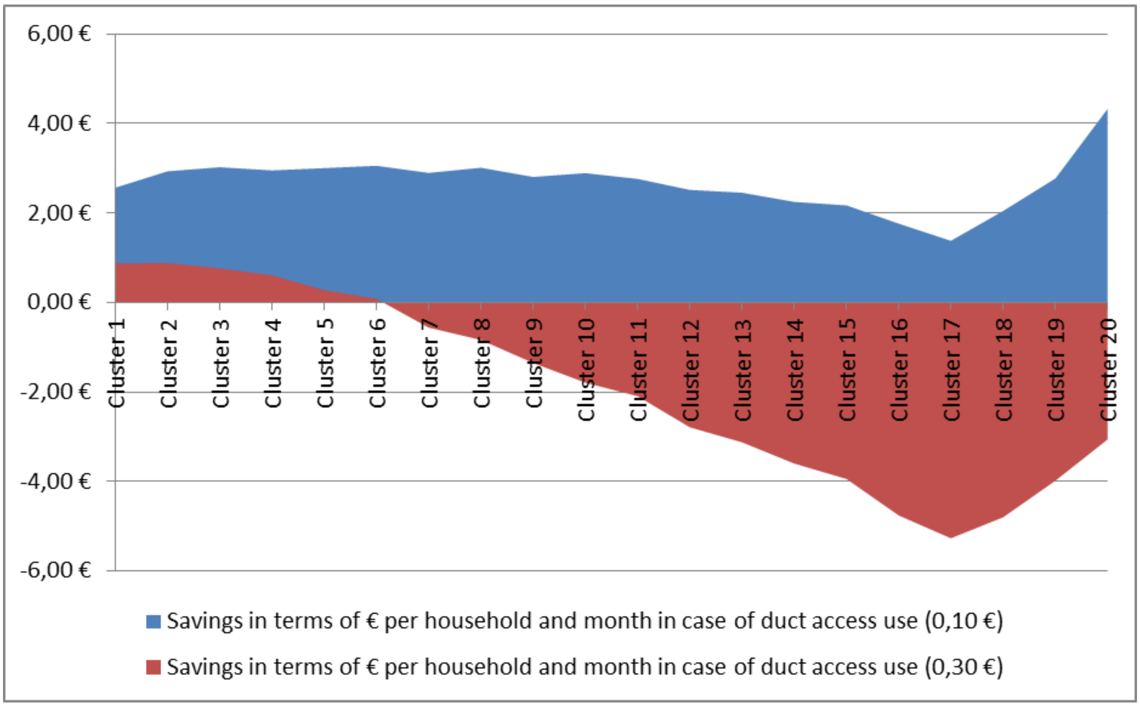


Source: WIK.

As illustrated in the following figure, research by WIK shows that achieving these effects requires low pricing for the PIA remedy,[505] a scenario which may not be possible under the application of the BB CRD to telecom PIA.

505 Lucidi and Ockenfels (2020) showed the importance of low costs for PIA to be effective in driving infrastructure competition. The authors calculated that in a best case scenario, where PIA is available in both the feeder and drop segment and the price of PIA is in the low range (close to €0.10 per metre per month), then the fibre roll-out costs for an alternative operators would decrease from 2000 € to 1500 € (-25%) per household. These cost savings would correspond to an average of 2.70 € per subscriber per month. If PIA was available only in the feeder segment however, the savings would be on average 0.38 € per month per subscriber. On the other hand, if the price for PIA is in the high range (around €0.30 per metre per month), it would not increase viability if available only in the feeder segment, and when available in feeder and drop segment, it would only lower the roll-out costs in the first 5 clusters (25% of the population).

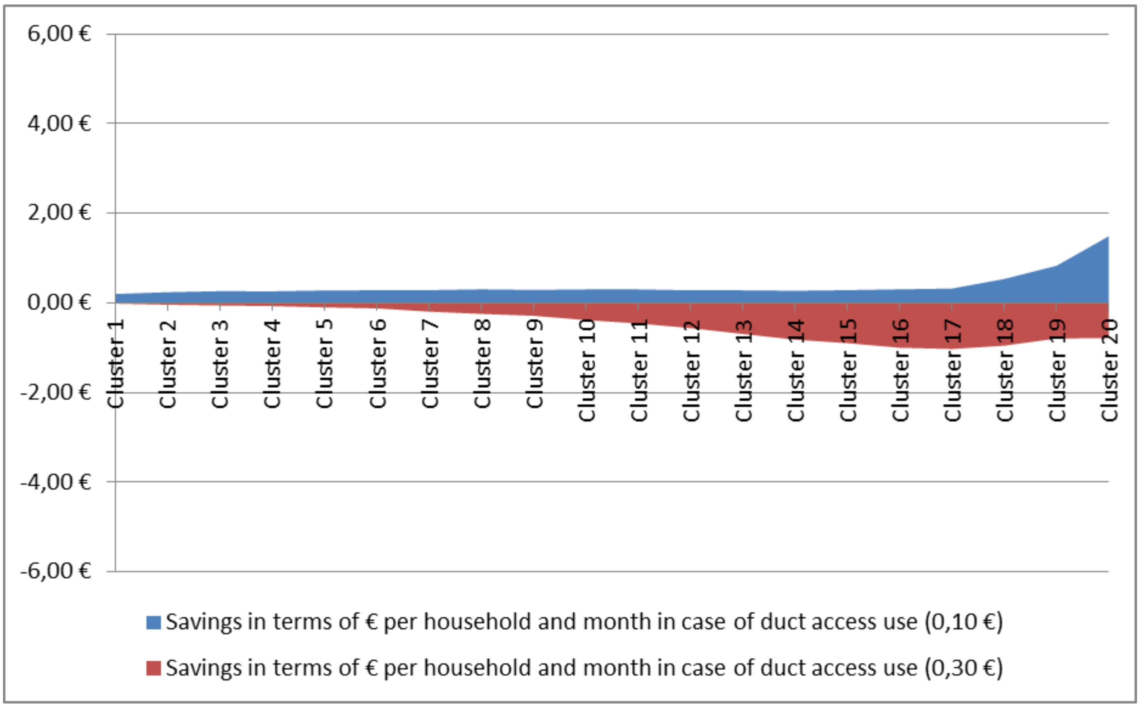
Figure 7-4: Savings due to duct access in € per household and month per cluster (feeder and drop segment)



Source: WIK.

Moreover, the impact of PIA on the potential to reduce costs and increase the scope for infrastructure competition, is limited if PIA is not available across the whole length of the access segment, as shown in the following figure.

Figure 7-5: Savings due to duct access in terms of profit/loss per subscriber and cluster (only feeder segment)



Source: WIK.

Notwithstanding these limitations, our estimates[506] suggest that, where PIA can be mandated and is effective, investment savings for alternative fibre operators could realistically lie around 10% (where PIA is available in feeder and drop segment in 40% of cases) and in the best case 25% (where PIA is available in feeder and drop segment in 100% of cases). Thus, in these circumstances, PIA would extend the viability of FTTH deployment for alternative operators able to achieve a relatively high market penetration, enabling them potentially to act as first movers in otherwise unserved areas (including areas funded via state aid), as well as potentially duplicating infrastructure in densely populated areas.

As regards the impact of PIA on competition, it can, as previously discussed, support the development of infrastructure-based competition in dense urban areas. Although these areas may themselves cover only a limited proportion of households, experience from countries such as Spain and Portugal suggests that alternative operators engaging in FTTH deployment via PIA may be able to gain greater leverage to negotiate co-investment and/or

506 In order to estimate what could be the potential cost savings associated with effective PIA more widely across the EU, we applied some of the findings from these studies to a model prepared by WIK in the context of a recent study for the Commission in implementation of CEF2. The model draws on detailed data from the German market, and extrapolates the results to other countries based on a labour cost index, as this is main cost-driver for PIA and fibre deployment. We applied this model to an alternative operator deploying FTTH to 90% of households with 40% market share, and assuming PIA costs of €0.10 per metre per month.

access in areas where they had not deployed their own infrastructure.[507] The importance of effective implementation of PIA for the development of co-investment was also a key finding from a 2018 study that WIK-Consult conducted for the German NRA BNetzA.[508]

The presence of larger scale players providing VHC services (as may occur with a focus on PIA and support for co-investment) could also improve the prospects for competition in the provision of wholesale local access, bitstream and wholesale leased lines.[509] However, this depends on the conduct of the players concerned. Ultimately, competitive conditions downstream from PIA including commercial wholesaling practices by alternative operators as well as the incumbent would need to be examined in an analysis of the markets concerned.

In addition to facilitating FTTH deployment by alternative operators in unserved zones (such as those supported by state aid) and densely populated areas, PIA can also be used to support deployment of point to point fibre targeted at business use.

In the access segment, the cost savings available as a result of effective low cost PIA (i.e. 10% in a realistic scenario or 25% where PIA is widely available) would apply also to the provision of dedicated fibre infrastructure for business (leased lines), when deployed as part of a mixed mass-market and business fibre deployment. The geographic scope for infrastructure-based competition in dedicated access from mass-market FTTH providers would likely be the same as the geographic scope in which duplication of FTTH is viable in the presence of PIA i.e. between 10-30% according to experience in France, Spain and Portugal.

In addition, PIA could support infrastructure competition in dedicated leased line provision from specialist business operators. Such providers would benefit from cost savings compared with deploying in the absence of PIA. Moreover, their scope to build is supported by the additional ARPUs associated with leased lines arising from the value added services provided to businesses and increased willingness to pay compared with consumers.[510]

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507 Vodafone in Spain and Portugal, and Orange Spain have their own infrastructure in certain areas based on FTTH and/or cable (in the case of Vodafone). Such infrastructure has been used to negotiate reciprocal access arrangements on an infrastructure swap basis in areas in which they do not have access networks. Such arrangements exist between Orange Spain and Vodafone in Spain, and between Vodafone and MEO, and Vodafone and NOS in the Portuguese market.

508 Tenbrock et at (2018).

509 For example, in the context of its 2020 consultation on the WCA market, ARCEP noted that SFR and Free have deployed infrastructure using duct access and on that basis are offering wholesale passive access to the fibre terminating segment (in line with symmetric access obligations applied in France). SFR is also said to offer bitstream (WCA) over its FTTH network on a commercial basis. Certain operators in the French market have also made use of PIA to deploy wholesale only fibre networks over which they offer passive (and in some cases) active access see ARCEP (2020, para 3.2.1).

510 Available evidence suggests that the ARPU uplift could be as much as 10 times (or more) than the ARPU reported for residential customers, although this includes the additional cost associated with higher service levels and specialist equipment. ARPUs derived by Newstreet from the financial statements of the largest broadband providers, show that in 2018 fixed connections were associated with average revenues per user of €32.60 in France, €43.70 in Spain, €27.70 in Germany and €22.60 in Sweden, while estimated ARPU for mass-market FTTH was €34.37 for residential customers in the context of WIK's study on the replication of NGA networks. In contrast, average prices for symmetric 100Mbit/s connections for business were reported

Competition from mass-market FTTH providers coupled with competition from business specialists may mean that competition for leased lines for businesses could be more intense than that possible for mass-market FTTH, and possibly extend beyond the footprint of FTTH infrastructure competition if PIA is available and effective.

It should be noted however that available evidence and interviews conducted for this study with providers of business services suggest that the effects and associated benefits from PIA for specialist business use are still unlikely to be nationwide. This view tends to be confirmed by the 2016 market analysis by ANACOM, which identified non-competitive zones for higher bandwidth leased lines despite the presence of comprehensive PIA regulation,[511] and the 2020 market 4 proposals by ARCEP, which also observe that differences remain in the degree of competition in fibre-based dedicated access between different areas, notwithstanding the availability of PIA.[512] Lack of competition outside dense zones/business districts is also one potential reason why less competition was observed for multi-site businesses in Spain, although the CNMC analysed the market on a nationwide basis. Moreover, it is clear from modelling conducted by WIK in the context of CEF2 Digital and the approval of national state aid, that there are areas in which fibre deployment for businesses (socio-economic drivers) as well as residential customers (and even backhaul) may not be viable, even in the presence of PIA remedies.

The cost savings made possible via PIA could also be an important enabler in supporting the deployment of 5G backhaul, extending the ability of alternative mobile operators to (co)deploy their own fibre capacity. Like business fibre connections, fibre for 5G backhaul is likely to be associated with higher revenues than a consumer connection, as it aggregates traffic from multiple users. Thus, where available, PIA may support the viable duplication of mobile backhaul for 5G across a greater proportion of the territory than applies for mass-market FTTH.

The prospect of infrastructure competition from PIA could present a threat to regional operators which have already invested in or are planning to expand VHC networks. Such a threat may take the form of duplicating their FTTH network, being first to deploy in an area which such operators have already targeted, or deploying infrastructure for „high value“ clients or locations such as large businesses or mobile antennas.

Such effects are likely to be most pronounced in areas where only one network is viable (with or without state aid). However, although PIA regulation may pose a potential competitive threat to some regional operators, the effect on VHC deployment need not be negative, as for currently unserved areas, lowering entry barriers through PIA could lead to a race to

in United Minds (2015, Figure 3.1.1) at €727 in Paris, €1203 in Berlin and €338 in Stockholm in 2015. Even if the prices of these lines continued a downward trajectory, matching the declines in pricing reported between 2011 and 2015, they would still be an estimated €627 in Berlin, €207 in Stockholm and unchanged in France.

511 Case PT/2016/1890.

512 ARCEP (2020, Section 4.5.4)

deploy, with the second mover deferring its investment in the new area.[513] Moreover, the likelihood of a new entrant or alternative investment using PIA to duplicate the existing infrastructure of a regional operator in an area which cannot be competitively served is limited, since the business case for that new operator would also likely be negative, unless it had a very high retail market share of customers that could be migrated to the new network. The threat of overbuild is most pronounced from incumbent, which typically has its own duct and pole network and a relatively high retail market share. However, this threat would not be affected by the creation of a separate PIA market or better enforcement of SMP PIA. The most likely implication of stronger PIA on the business case for VHC deployment by an established regional operator would in fact be reduced revenues arising from selective deployment of (and therefore infrastructure competition in) connections for large business customers and for mobile backhaul. However, such deployment could be considered important for resilience and may reduce the risk that the regional operator may be found to have SMP itself in such connections (in the context of the dedicated access market). The effect on the overall business case for a regional fibre operator of this targeted form of infrastructure competition is illustrated in Figure 7-1. The most rational response to the threat of such a loss of revenue is likely to be to make attractive offers available for wholesale products such as dark fibre or leased lines. In any event, the implications on mass-market VHC deployment strategies for regional operators seem unlikely to be materially affected.

From a customer perspective, increased availability and infrastructure competition in VHC and dedicated connections, resulting from a greater focus on PIA implementation, should serve to boost the quality of connections and (in the absence of oligopolistic conduct) result in more competitive retail pricing. An idea of the possible effects on mass-market broadband of PIA, can be seen by examining the coverage of FTTH and associated speeds, choice and prices available for higher bandwidth broadband retail services in cities where duct and pole access has been mandated in the absence of any VHC access obligations on the incumbent, and comparing these results with outcomes in cities which lack effective PIA.

For example, the data in the table below shows that, as of 2017, high FTTH coverage had been achieved in Paris and Madrid – areas benefiting from effective PIA remedies (and no VHC regulation), while coverage was lower in cities such as London and Hamburg, which at that time did not have comprehensive PIA remedies in place and instead focused remedies on access to VHC networks.

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513 In France various measures have been introduced to support the use of PIA to support complementary rather than overlapping VHC deployments in less dense areas, where duplication is unlikely to be viable. These include the requirement for operators to provide declarations concerning the zones which they intend to serve with FTTH, with the intention that “first movers” have some time to deploy before the zone is considered open to investment by others. Another practice which is aimed at avoiding overbuild is that operators deploying fibre in segments of the duct network which are “mutualised” (i.e. where only one fibre network is considered viable) do not need to leave space for others to deploy. Different rules apply for operators deploying fibre in duct segments which are not mutualised.

Table 7-1: Coverage by technology Q1 2017

	Hamburg	London	Madrid	Paris
FTTH/B	71.4%	4.5%	>90%	90%
FTTC/VDSL	>90% (est)	95%	Limited	Limited
Docsis 3.0	>50%	65%	~50%	High
LTE[514]	68%	74%	80%	68%

Source: WIK (2017c).

The quality of fixed and mobile connections, measured in terms of average download speeds, was also higher in the cities benefiting from infrastructure competition via duct and pole access.

Table 7-2: Average fixed and mobile Internet download speeds 2016

	Hamburg	London	Madrid	Paris
Average download Mbit/s	29.02	28.79	48.08	71.74
Mobile speeds Mbit/s	15.65	16.77	18.84	19.37

Source: Ookla Netindex (extracted from European Digital City Index 2016)

Comparisons of value for money on the other hand varied, with Gigabit broadband offers available at less than €40 per month in Paris in 2017 (and today), while in Madrid, the same price at that time procured broadband at bandwidths of 300Mbit/s.[515] These outcomes may reflect different costs or conduct amongst broadband providers in more concentrated markets. It should also be noted that (as observed in various WIK studies)[516] promotion of infrastructure competition through PIA is not the only strategy which can improve outcomes for consumers. The existence of wholesale only networks (especially those based on passive infrastructure) can also be associated with improved end-user outcomes.[517]

Competition problems affecting customers that cannot be addressed through the PIA market alone (coupled with appropriate non-SMP measures), would need to be examined in the context of the review of downstream markets.

514 % time LTE is available to end-users as measured by Opensignal (2017).
515 WIK (2017c).
516 See also discussion in WIK (2016a).
517 In WIK (2017c) positive outcomes were seen in terms of choice, price and quality in Stockholm (featuring a passive wholesale only network), in addition to Paris. Positive outcomes from wholesale only networks were also highlighted in WIK (2019i): Competition and investment in the Danish broadband market, https://www.wik.org/index.php?id=1178&L=1

This evidence all points to the potential benefits that effective PIA implementation could bring to VHC deployment, competition and end-user welfare.

7.2.2.5 Summary

PIA is likely to be more effectively implemented through SMP regulation than through enforcement via the BB CRD. A separate PIA market is likely to involve an increased administrative burden compared with the approach of mandating PIA as a remedy in the WLA market. However, defining a separate PIA market will likely be necessary (at least in the medium term) to reflect the characteristics of market and appropriately apply PIA and facilitate downstream deregulation (or regulation of different SMP providers) in countries where SMP PIA is the primary enabler of infrastructure competition and new entry.

Mandating SMP PIA as a remedy based on article 72, or through inclusion in the market definition for WLA is likely to be more cost-effective and appropriate in other cases (where SMP PIA is not and is unlikely to become a key enabler for infrastructure competition). This approach could be a valuable option for a transitional period in countries where SMP PIA could be a significant enabler of infrastructure competition and entry, but its effect is not yet clear in the market.

Where PIA is a relevant remedy, its effects on VHC deployment, competition and end-user welfare can be significant, contributing both to increased infrastructure competition (in dense urban areas) and competition for deployment in areas supported by state aid. However, detailed ex ante regulatory intervention, cost-oriented rates and availability of PIA across at the least the whole of the access network are likely needed to achieve these effects. PIA could also be an important enabler of competition in dedicated lines for business and SEDs, as well as for the deployment of fixed and mobile backhaul (including for 5G).

Table 7-3: Impact of different options for PIA regulation compared with the status quo

	VHC deployment and access		Competition		End-user welfare			Single market	Admin. cost
	Availability	Take-up	Inf	Serv	Choice	Price	Quality		
Option 1: Separate PIA market	+/-	+/-	+/-	+/-	+/-	+/-	+/-	0	--
Option 2a: PIA handled via SMP remedies (art 72 Code)	0	0	0	0	0	0	0	0	0
Option 2b: PIA handled via BB CRD	-	-	-	0	-	0	-	-	---

+,-, 0: Positive, negative or no effect compared with status quo. (+) some possible effect, or effect limited in geographic scope. +/- effect depends on circumstances

Source: WIK-Consult based on benchmarks, modelling and interviews

7.3 Wholesale data connectivity

7.3.1 Relevant options

7.3.1.1 Option 1a: Single wholesale broadband market recommended for ex ante regulation in the list of relevant markets susceptible to ex ante regulation

Under this option, a single broadband wholesale broadband/data access market would be included in the Recommendation on Relevant Markets. The market would encompass physical, virtual and bitstream (Ethernet and IP-based) access at local and regional access points. FTTx and cable technologies would be included within the scope of the market, as would copper and FWA, to the extent that they provide a constraint on VHC-based services.

NRAs would be advised to further segment the product and geographic market as required to reflect national circumstances. Thus, a wide market might be defined in some countries e.g.

where cable bitstream is relevant, while segmentations between passive and active, or local and regional, might be found in other cases. In circumstances where copper no longer provides a constraint on VHC technologies, NRAs might find that the competitive conditions differ between different regions, and they may find it appropriate to geographically segment the market, according to the principles outlined in section 5.2.10.

7.3.1.2 Option 1b: Wholesale local access only included in the relevant market recommendation, WCA not included

Under this option, a more narrowly defined market for wholesale local access would be included in the Relevant Market Recommendation. This market would be the same in scope to the current market 3a, encompassing physical access (unbundling) alongside „virtual“ access that meets certain specifications, which aim to ensure that the capabilities of the access are as close as possible to those available through physical unbundling. The market would include access made available at a „local“ access point, which may, in view of the changes to network architectures in an NGA environment, include access that is further from the end-user than is typical for copper local loop unbundling (see section 5.2.5.2). FTTx-based unbundling and VULA would be included within the scope of the market, as would copper unbundling and VULA on upgraded copper networks, to the extent that these technologies provide a constraint on VHC-based services. Cable would not normally be included as a direct constraint, due to the limited potential to achieve VULA-like service during the period of this Recommendation (although may provide indirect constraints). Inclusion of FWA as a direct constraint would depend on the degree to which it substitutes for the capabilities of VHC and (where relevant) copper-based technologies, and the potential to provide VULA via this technology.

Especially in circumstances where copper no longer provides a constraint for VHC, NRAs might find that the competitive conditions differ between different regions, and they may find it appropriate to geographically segment the market, according to the principles outlined in section 5.2.10.

The market for wholesale central access would not be included within the list of relevant markets potentially susceptible to ex ante regulation, as this market has been found not to meet the 3 criteria test (see section 5.2.6.2). However, it would remain possible for NRAs to apply regulation in this market if it meets the 3 criteria test as assessed at a national level.

7.3.1.3 Option 2: Market not listed in the list of relevant markets susceptible to ex ante regulation, but other options remain available

Under this option, there would not be a market for mass-market wholesale broadband access included in the list of markets considered susceptible to ex ante regulation. However, other options for wholesale access would remain where justified, including notably, the potential under article 61(3) of the Code to impose wholesale access obligations, on reasonable request, to wiring and cables and associated facilities inside buildings or up to the first concentration or distribution point.

Competition law remedies would also remain available in cases involving mergers, state aid, or in the event of abuse of a dominant position.

7.3.2 Impact assessment

7.3.2.1 Regulatory implications

Under the wide market scenario, market analyses in some countries, such as Denmark and the Netherlands,[518] where regional bitstream is prevalent and NRAs have proposed to define a combined 3a/b market, may be unaffected. However, for most member states, the identification of a single market at EU level would prompt questions as to whether the approach taken at national level should also be to combine markets 3a and b, or whether segmentation should be conducted at national level between WLA and WCA, passive and active access. In the absence of clear guidance at EU level, the scope and segmentation of the product markets defined at national level may diverge. With its continued inclusion within the scope of the relevant market Recommendation, where SMP is found it is also likely that regional bitstream access would continue to be mandated at least for some countries and/or in some regions. There may also be a blurring of the distinction between physical access and other forms of access which entail significant flexibility for access seekers, and bitstream access which provides less scope for access seekers to differentiate. This may undermine efforts to ensure the availability of VULA at local access points which permit maximum use of own or competitively supplied backhaul. Another potential outcome from the definition of a broadband market might be that „no SMP“ is found in more countries than is the case today. This may stem from inclusion of a greater variety of technologies (such as cable and potentially FWA) products (including commercial bitstream offers) and suppliers in the market. The annulment by the appeals tribunal of ACM’s decision to define a wide market in which two operators have „joint SMP“, may be a harbinger of the potential implications of such definitions, if introduced more widely across Europe.

Under the narrow (WLA only) scenario, the scope of the relevant market and therefore NRA’s analyses would be unchanged compared with current practice (except for the removal of PIA from consideration if treated as a separate market). However, the removal of the WCA market from the list may prompt additional focus by NRAs on implementing wholesale products which meet the VULA specifications, in countries which have not yet done so, and may focus more attention on supporting the deploying of FWA solutions in rural areas, and ensuring the availability on competitive terms of backhaul to rural communities.

518 It should be noted that the scope of the wholesale broadband markets in the Netherlands is subject to review, following the annulment of ACM’s combined market 3a/b analysis.

The removal of the WCA market from the list of relevant markets would entail reduced administrative costs for NRAs and operators, as no separate market analysis would need to be conducted. However, data gathering on the WCA market would need to continue as a measure of whether this market remains effectively competitive in the absence of regulation.

As migration towards VHC networks progresses, an increasing number of countries are likely to find that copper no longer provides a constraint for VHC broadband at the retail or wholesale level. This may result in the need (especially if PIA is no longer included within the scope of wholesale broadband markets) for more detailed geographic market analyses. Depending on the market structure in each member state, such geographic analyses could result in certain areas being found effectively competitive and deregulated, and/or in some non-incumbent operators being found to have SMP in specific geographic regions. These implications are expected to be the same regardless of whether a single (broadband) market or narrow WLA market are defined at EU level. If PIA remains within the scope of wholesale broadband access markets, these markets are more likely to be found to be national in scope, but NRAs may then apply geographic segmentation to VHC remedies. Given reduced levels of oversight at EU level for remedies compared with market definitions, it is possible that geographic segmentation of VHC remedies may be conducted in a less harmonised manner than geographic segmentation of the market.

The removal of both the WLA and WCA markets from the list of relevant markets would entail reduced administrative costs for NRAs and operators associated with the market analysis process. However data gathering would still be advisable, and (in view of the barriers to competition that exist in certain areas in the WLA market (see assessment of the 3 criteria test at section 5.2.6.1)), it seems likely that some NRAs would seek to replace SMP-based regulation with a more extensive application of symmetric regulation under article 61(3) of the Code. As provisions regarding symmetric regulation are less elaborated than those concerning SMP regulation, there is scope in this context for a greater variety of approaches across the EU. Application of symmetric regulation, at least in an initial period, could also entail greater reliance on dispute resolution involving different parties, which could be more resource-intensive than conducting a market review process. Additional administrative burdens would likely fall on operators not designated as having SMP, under a symmetric regulatory regime compared with one based on SMP regulation.

In countries where NRAs choose not to implement more extensive symmetric regulatory approaches, and instead to fully deregulate wholesale broadband access, the administrative burden on all operators resulting from ex ante regulation would be reduced. However, there may be increased burdens arising from commercial negotiations and potential legal challenges in case of (constructive) refusal to supply.

7.3.2.2 Administrative costs

16 of the NRAs responding to the survey gave provided information about the resources required to conduct a market analysis of the WLA and WCA markets and/or a combination of the two. A significant number (half of those responding) reported that analysis of these markets required resources in excess of 1,000 man days, although some NRAs reported concluding these market analyses in significantly less time.

Of the 11 NRAs reporting on the time taken to analyse the WLA and WCA markets separately, 3 reported that significantly less time was spent on the WCA market than the WLA market. In one case, where the WCA market had been deregulated, the NRA reporting spending only one tenth of the time on this review compared with WLA, as part of a monitoring exercise. However, equal time was reported by a significant number of NRAs, especially in Eastern Europe, highlighting the ongoing perceived significance of this market in some EU member states, while some NRAs reported that no time would be saved by removing the WCA market, as it would nonetheless continue to be analysed.

Those NRAs which commented on the implications of combining markets 3a and b mostly considered that it would not make any difference to the time spent, as those markets were already reviewed in tandem, while one respondent suggested that the process could be made more complex in this scenario. NRAs already conducting a merged analysis would be unaffected.

NRAs generally considered that the expectations introduced in the Code around mapping, coupled with geographic segmentation of the WLA market or combined market would require considerable additional resourcing compared with a national market analysis. Some NRAs had experts or consultants dedicated to this exercise. TRAFICOM, the Finnish NRA, which has designated 21 SMP operators in markets 3a,b and 4 noted that multiple SMP assessments created a very high regulatory burden and that the Recommendation should seek to take into account the prospect in some countries of multi-operator broadband market environments, and give guidance to support the simplification of broadband analyses in this context.

Those NRAs which commented on the possibility of relying on symmetric access regulation (under article 61(3) of the Code), as an alternative to SMP regulation, considered that it was not suitable for this purpose and would require additional resources compared with SMP regulation as obligations would need to be imposed on all operators, most likely in the context of resolving disputes. Symmetric access regulation was rather considered, where relevant, to be a complement to the SMP regulation of access networks e.g. to address bottlenecks in in-building wiring, although France presents a notable exception to this approach.

As expected, resources required for the incumbent to engage in market analysis proceedings related to fixed access markets were significantly higher than those of individual non-incumbent operators (4 FTEs), and were of a similar magnitude or higher than the resources attributed by many NRAs to market analysis proceedings, likely due to the incumbent's direct engagement in price control proceedings, accounting separation and the preparation of Reference Offers. Those responding to the questionnaire did not observe a significant saving in resources associated with conducting a WLA market alone compared with conducting a combined analysis of the WLA and WCA markets. The incumbent responding considered that the effort involved in addressing issues concerning symmetric regulation was the same as that that would have been associated with SMP regulation. However, non-incumbents raised concerns that a switch towards a focus on symmetric (rather than SMP regulation) on wholesale access, would impose additional costs, due to widening the number of affected operators and the complexity of the dispute driven process.

7.3.2.3 Implications for stakeholders

Incumbent operators

Incumbent operators, which are currently designated as having SMP, are likely to be the main beneficiaries of a wider EU-wide definition of wholesale broadband markets, which includes cable and bitstream within the scope of the market. Where such an approach results in a „no SMP“ finding, incumbents would benefit from the removal of regulatory obligations, while in cases where SMP is found, incumbents may benefit from obligations which are focused higher up the value chain (at bitstream rather than physical unbundling/VULA), thereby allowing them to retain greater „value add“ in the specification of the wholesale product. Conversely, although the removal of the WCA market could lift some existing regulatory obligations on incumbents, a focus on a narrow WLA market definition could have a negative impact for them, if it results in a greater focus on the implementation and enforcement of VULA. Removal of wholesale broadband markets in their entirety would benefit incumbents if it results in the removal of regulation as a whole. A move towards symmetric regulation in place of SMP regulation could be neutral or positive for incumbents (if it equalises the regulatory burden for competitors and increases the potential for incumbents to access alternative networks). However, imposition of symmetric regulation in a manner which requires them to install specific (unbundleable) architectures (as in France), may be a worse outcome for incumbents than SMP access obligations which fall short of these measures.

Cable operators

Cable operators are likely to experience uncertainty from the inclusion of a broad market, as it could either result in no SMP and the removal of wholesale broadband access regulation (which would indirectly benefit them) or in joint SMP designations, requiring them to make cable bitstream access available on regulated terms. The inclusion of a WLA (but no WCA) market would be broadly positive for cable operators as their technology may not be encompassed within the WLA market,[519] and the WCA market (which typically does include cable) would no longer be considered to be „susceptible to ex ante regulation" on an EU-wide basis. If the removal of wholesale broadband markets results in the removal of regulation as a whole, this would be positive for cable operators. However, a shift towards symmetric regulation would likely be negative, unless limited to deployment of fibre optic cables.

Regional investors

Vertically integrated regional investors, whose technologies are more likely to fall within the same relevant market as those operated by incumbents, could benefit from the lifting of regulation or bitstream regulatory focus that may be associated with a wider market definition. However, this depends on the conduct of the incumbent and whether they are at risk of predatory pricing in the areas in which they are seeking to deploy fibre. New entrant regional or national investors pursuing a wholesale only model may also be adversely affected by changes in (or removal of) access obligations on the incumbent which reduce the overall market shares (and thereby marketing power and financial strength) of alternative operators that rely on their infrastructure. Including only WLA and not WCA in the list of relevant markets may have limited impact compared with the current situation, although increased focus on WLA may improve the conditions for access to incumbent infrastructure making it more attractive for access seekers (compared with access from regional operators), while reduced regulatory focus on WCA could risk predatory practices if the incumbent is able to lower prices for such access in areas of competitive threat. The removal of wholesale broadband access from the list in their entirety could be positive for regional investors if it results in a removal of regulation, and could also prompt some alternative operators to seek access from alternative sources to the incumbent. However, it could also be negative if it increases the risk of predation or threatens the business model of alternative operators that may rely on access to regional investors' networks. Replacement of SMP regulation with symmetric regulation would generally be negative for any regional investor not meeting the criteria for exclusion from regulation (such as wholesale only) under article 61(3) of the Code.

Access seekers (including MNOs relying on access for bundled offers)

Access seekers are likely to be put at a significant disadvantage by a broad market definition, which risks a no SMP finding, or greater reliance on bitstream regulation. A narrow WLA market which prompts greater focus on VULA/physical unbundling regulation should benefit access seekers making investments in core and backhaul infrastructure. However, the removal of WCA markets, may disadvantage smaller scale fixed operators (and multi-national business specialists), if wholesale offers are not maintained on a commercial basis, as it may require them to invest in or obtain access to backhaul infrastructure, which may not be viable when market shares are limited. Access seekers would also be disadvantaged by a

519 Based on the assumption that DOCSIS 4.0 is unlikely to be deployed in the short to medium term.

focus on WLA in markets where cable networks are present and outperform the incumbent infrastructure (such as Netherlands, Belgium and Denmark), as removal of WCA could prompt deregulation of cable bitstream and/or support challenges against the regulation of cable bitstream in the courts.

In the absence of commercial wholesale access, operators without wireless/mobile networks may be unable to provide services to more remote communities, and may face stranded assets. Access seekers would be significantly and negatively affected by the removal of wholesale broadband access markets from the list of relevant markets, especially in the event that it results in the removal of all ex ante obligations including VULA and unbundling. Access seekers could benefit from a possible replacement of SMP access obligations with symmetric obligations. However, experience in France suggest that this may advantage larger-scale (mass-market) access seekers, potentially to the detriment of smaller ISPs and business specialists, since it is envisaged that symmetric access is normally provided only up to the first distribution point, which is deep in the network.

7.3.2.4 Impact on VHC connectivity, competition, end-user welfare and the single market

<u>Broad market (combining 3a/b)</u>

The implications of a broadband wholesale broadband market on VHC connectivity are difficult to gauge, because the outcomes of this solution could range from „no SMP“ to increased bitstream regulation focus, to a continuation of the status quo, where NRAs continue to segment the market as they have done previously. However, if this scenario (which is supported by many incumbents) is seen as broadly deregulatory, then it could encourage further VHC deployment by incumbents, cable operators and certain regional investors, in cases where these stakeholders may previously have been deterred by strict wholesale local access obligations on VHC networks. It could also (in the presence of availability and effective regulation of PIA) encourage further investment or co-investment by access seekers in the event that they are concerned that they may be deprived of the option for regulated wholesale access in a manner which supports flexibility and innovation.

Although it may result in increased infrastructure competition, it is expected that this would be limited to densely populated areas where such competition is viable. More generally, the definition of a broadband market encompassing WLA and WCA, is expected to weaken or reduce the focus on physical and VULA-based remedies – and as such is likely to limit the degree of competition in VHC broadband in less dense areas.

A reduction in competition outside very dense areas (or greater reliance on bitstream as opposed to local physical access or VULA), is liable to reduce competition in quality for end-users, potentially resulting in lower bandwidths being available than can be supported by the underlying infrastructure or in tiered pricing which deters take-up of higher bandwidths.

In this context, it is interesting to note that in a study of the comparative effects of physical unbundling, infrastructure-based competition (from cable) and bitstream access in the UK, Nadotto, Valletti and Verboven found that both cable competition and local loop unbundling were associated with an increase in broadband quality. However, no such effect was visible in areas where competition was based on bitstream access, because service providers could not differentiate their offer in terms of the service provided.[520]

In contrast with unbundling and cable competition, competition based on bitstream was also found to have a negative effect on Telefonica's fibre deployment in a 2017 research paper by Calzada et al.[521] Pressure on Telefonica to invest in the presence of unbundling may have been due to the potential for competitors relying on unbundling to compete on quality as well as the threat that they might further climb the ladder of investment. Conversely, the authors note that in areas where bitstream was prevalent, competition was weaker overall, but additionally, Telefonica was able to obtain larger wholesale revenues from its competitors, and thus its incentive to deploy fibre was reduced.

Importantly, a wide market solution at EU level would also likely result in a wide variety of solutions being adopted in different countries across Europe undermining the potential for cross-border entry and supply.

Narrow market (WLA only)

Defining a narrow market (WLA only) at EU level is likely to be neutral as regards deployment of VHC by incumbents and regional investors, as it represents the „status quo". However, if it results in a tightening of local access regulation and increased availability and improved specifications for VULA (due to the removal of the WCA market), it could limit the incentives for incumbents to expand VHC deployment in areas where they are the only credible investor. Such effects could however be mitigated through the approach to regulation in such areas.[522]

Removing cost-oriented bitstream access obligations could improve the business case for the incumbent (or alternative investors) to deploy VHC in rural areas, especially in cases where deaveraged pricing is possible.

A WLA only market is likely to result in maintained or increased competition on the basis of WLA, but potentially reduced competition in areas or customers currently served via WCA (currently those in rural areas or relying on copper), and which cannot be reached through better availability of backhaul coupled with WLA. Such an effect may not however

520 VOXEU (2012).
521 Calzada et al. (2017)
522 For example, the Portuguese NRA ANACOM did not impose an obligation for the SMP operator PT/MEO to offer access to its VHC network in areas where it had not yet deployed FTTH to any significant scale, on the basis that it considered that such forbearance could boost investment incentives. Further discussion and backhaul on this case can be found in WIK (2019e).

materialise, if competitive FWA solutions are more widely deployed in these cases and/or if commercial bitstream access offers are maintained following the removal of regulation.

An intensified focus on WLA regulation, if it includes unbundled fibre access or improved specifications for VULA,[523] should result in increased quality, choice and value for money in VHC broadband, for consumers in areas which do not benefit from infrastructure-based competition (e.g. based on PIA or other sources). The effects on quality and price of competition based on VULA are likely to be less pronounced than those made possible via unbundling, as no innovation is possible in the active equipment used to drive the connection. However, the bandwidth independent tariffs and additional flexibility that should be associated with a properly specified VULA product, should in theory result in a greater degree of quality and price differentiation than is possible via a bitstream product.

While effects on quality and price for consumers which can receive offers based on physical unbundling or VULA should be positive from an increased focus on WLA and associated backhaul, the removal of WCA bitstream obligations could limit the potential for smaller scale operators (and potentially business only) operators to enter the market and achieve widespread national reach, if local access requires connections to be made close to end-users and if commercial offers for bitstream are not maintained on fair conditions following deregulation.

This effect is clearly illustrated in a model prepared by WIK-Consult for ACM on the economic feasibility for access seekers of using fibre unbundling in comparison with VULA and WCA bitstream – both of which require fewer connection points than fibre unbundling.[524] The model shows that an access seeker with 2% market share would have a negative margin if required to serve part or all of the Dutch territory with fibre unbundling, whereas the business case would be positive when using VULA or regional bitstream.

523 WIK (2018d).
524 Kroon et al. (2017).

Table 7-4: Overview of business case scenarios for small and medium scale alternative operators in the Netherlands

Scenarios	Margin (for base case of 2% market share)	Indicative margin (for hypothetical 10% market share)
1) National coverage with WCA KPN Copper & Fibre network	16.8%	16.8%
2) National coverage with VULA KPN copper network	12.8%	34.8%
3) Regional coverage with VULA KPN copper network	17.4% With 10 largest access points connected	35.8% With 10 largest access points connected
4) Complete network coverage with Fibre LLU KPN fibre network	-55.6%	2.7%
5) Partial network coverage with Fibre LLU KPN network	-25.8% With 10 largest access points connected	7.2% With 10 largest access points connected
6) National coverage with WCA for VodafoneZiggo coax network	14.4%	15.7%
7) National coverage with VULA for VodafoneZiggo coax network	-11.9%	35.6%
8) Regional coverage with VULA for VodafoneZiggo coax network	18.1% With 10 largest access points connected	41.6% With 10 largest access points connected

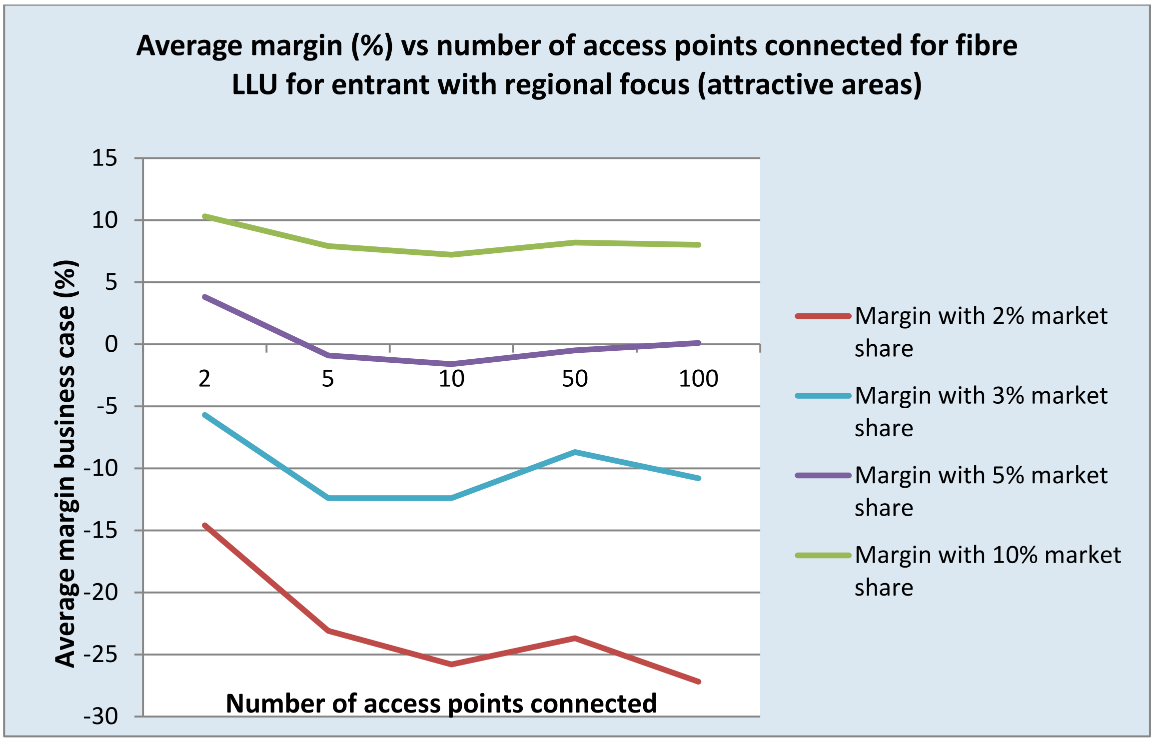
Source: WIK-Consult [525].

The figure below shows how the business case for an alternative operator, as assessed through the average margin, depends on the number of access points that need to be connected to reach the target customer areas (in this case more attractive areas). This illustrates that the effect of removing the WCA market on competition from smaller scale

525 Kroon et al. (2017).

operators will also strongly depend on the location of the local access point for physical unbundling or VULA.

Figure 7-6: Business case margin for scenario 5: entrant with partial network coverage based on LLU for KPN's fibre networks and connected access points



In turn, consumers or business sites which cannot be viably served via WLA and backhaul may experience reduced choice and/or higher prices in the event that FWA and commercial bitstream solutions do not materialise following the removal of WCA regulation. This effect would be more limited in the event that local access points, coupled with backhaul, aggregate a sufficient number of lines to support competition from alternative operators and business providers.

Removal of market

The removal of wholesale broadband markets from the list and associated deregulation of these markets might increase incentives for alternative operators and investors to deploy or co-deploy their own access infrastructure, triggering further investment in VHC by incumbents. However, in areas where there is little prospect of infrastructure competition due to the limited viability of duplication even in the presence of PIA,[526] these competitive dynamics may not apply, and there may be limited or no impact on the incentives for incumbent operators to upgrade to VHC.

526 Viability of duplication with PIA is discussed in section 7.2.2.3 and appears to range between 10-30% of households.

In those areas not benefiting from infrastructure competition, in the absence of appropriate WLA regulation, such as access to VULA and/or fibre unbundling, competition may be limited. It is possible that commercial agreements, including co-investment could bring competition to these areas. However, incumbents may have limited incentives to participate in such agreements on fair terms, and joint ventures or other agreements which assume an equal split in the upfront costs may not correspond with the relative market shares of incumbents and alternative operators. The terms of co-investment could be adjusted to address this concern,[527] and indeed the Code provides for a co-investment scenario which is considered sufficiently pro-competitive that access regulation could be relaxed.[528] However, the incumbent may not be willing to agree such terms in the absence of a regulatory threat. Thus, the inclusion of at least WLA as a market which is considered susceptible to ex ante regulation is also important to incentivise the achievement of commercial solutions, which could support competition.

In the absence of competition in areas without competitive supply, prices to consumers may rise and bandwidths may be artificially constrained or charged at higher prices.

The potential effects of a lack of any VHC access regulation in the presence of limited competitive constraints can be seen in the high prices charged for broadband at speeds above 100Mbit/s in the US (States of New York and California). In contrast, prices observed for these bandwidths in the EU, which does implement VULA and/or fibre unbundling regulation in countries and areas where infrastructure competition is insufficient,[529] are considerably lower. Average fixed broadband download speeds experienced by US consumers, measured by Ookla/Speedtest at 137Mbit/s in Feb 2020,[530] are higher than those in many European countries, suggesting that quality may not have been affected by the absence of access regulation. However, this may be due to the prevalence of cable across the US, which can be upgraded at relatively low cost. It is also notable that several countries with VHC access regulation in Europe, have experienced similarly high average speeds, without having full cable coverage - including France (139Mbit/s, Spain 132Mbit/s and Sweden at 134Mbits).

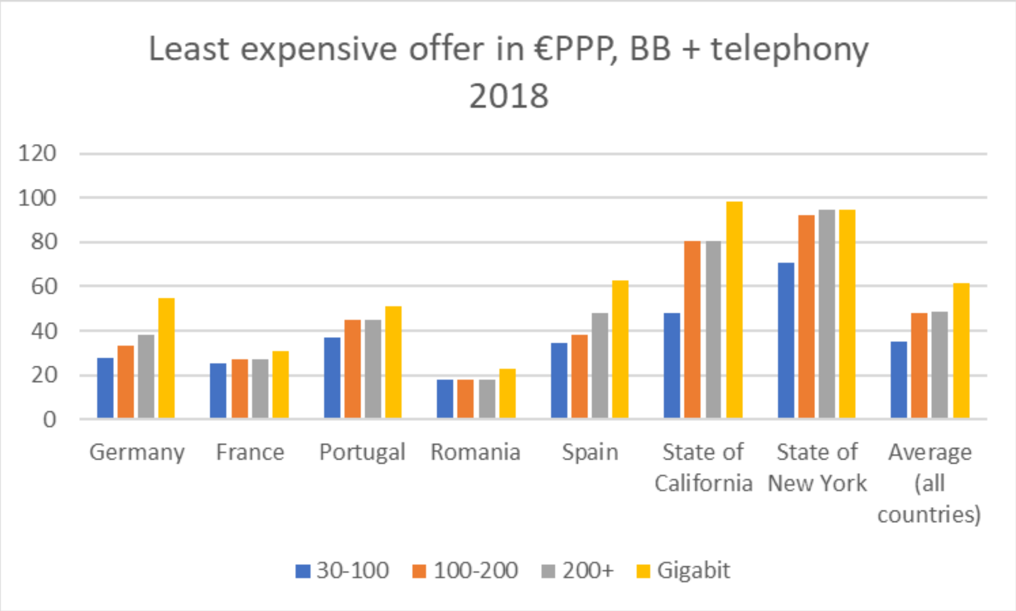
527 An alternative approach to a split based on equal cost sharing, would be to divide retail customer revenues into a wholesale and a retail component, thereby including a risk-sharing component (wholesale split approach). In contrast to the retail-only approach, the wholesale component is split among the co-investors according to their investment shares. The retail component remains with the company that won the end customer. Hence, the risk for all, significantly decreases with this combined wholesale/retail model as profitability no longer reacts so sensitively to the level of retail market shares. See discussion in Tenbrock et al. (2018).

528 Article 76 EECC.

529 Within the countries shown, VULA is mandated in areas covering around 65% of households in Spain, while fibre unbundling is mandated through symmetric access regulation to areas covering around 90% of households in France. VHC access obligations apply in principle in Germany, but FTTH has not been widely deployed, and therefore most VHC connections are based on unregulated cable offers. No VHC access obligations have been imposed in Portugal (due to the prevalence of co-investment resulting in many areas being served by three operators) and in Romania – due to infrastructure-based competition. In the US the degree of choice is typically limited to the incumbent and cable operators.

530 Speedtest (2020).

Figure 7-7: Prices for broadband and telephony by speed, leased expensive offer, 2018, selected EU member states and US states



Source: WIK-Consult based on data from the Nov 2019 study Fixed Broadband Prices in Europe 2018[531]

In the event that SMP regulation is replaced with symmetric regulation following the removal of the WLA and WCA markets from the list, the implications for deployment of VHC broadband may depend on the context and rules associated with symmetric regulation. A relatively extensive form of symmetric regulation may be an appropriate solution in cases where FTTH has not yet been rolled out, and is expected to be deployed by different operators in different local areas, which may need access to each other's networks. In this case, symmetric regulation coupled with a presumption that the first mover would have a de facto monopoly on VHC deployment could be positive for investment as it could stimulate a race to invest.[532] However, equally, this effect may not be present if there are limited prospects for VHC deployment by others than the incumbent. Moreover, there could be a negative effect on VHC deployment in the event that symmetric regulation on access pricing restricts the viability of deployment and/or fails to take into account different business models and costs that might be experienced by smaller regional operators, which would be subject to such obligations.

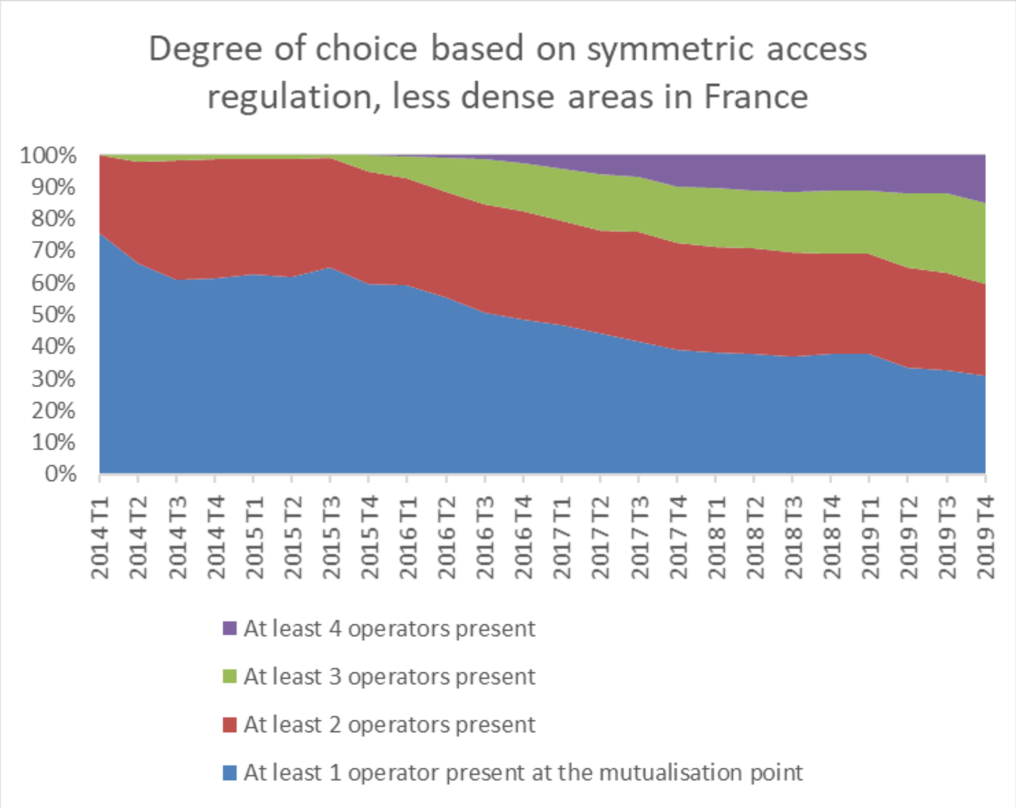
The French experience suggest that a degree of competition in VHC services in less dense areas can be supported by relying on an extensive form of symmetric regulation (up to the first concentration point at locations aggregating at least 1,000 households). As shown in the diagram below, 82% of households in commercially served less dense areas could receive 3

531 European Commission (2018a).

532 This was likely the intention of provisions in France which grant operators expressing an intention to deploy in a certain area a period in which to complete this deployment, before the area is open to investment by others.

or more offers, while 49% could receive 4 or more offers. However, the implementation of access via this route required extensive guidelines and dispute resolution by the NRA. Moreover, as the aggregation points are relatively small, competition via this route would likely favour larger scale operators able to connect at multiple points close to the end-user, potentially limiting competition from smaller ISPs and specialised business providers.

Figure 7-8: Degree of choice based on symmetric access regulation, commercially served less dense areas in France



Source: ARCEP observatory Q4 2019

Especially if symmetric regulation focuses on the provision of passive (unbundled) inputs, it could support competition in quality for end-users. However, as noted above such an approach may be more relevant prior to the widespread deployment of FTTH or in cases where point to point FTTH has been deployed.[533] In other cases, where FTTH PON infrastructure has been deployed, wholesale access may need to be based on bitstream, which limits the scope for innovation and differentiation. Moreover, although it is possible in certain circumstances, mandating active access via symmetric regulation could be viewed as

533 This was the conclusion reached in WIK (2019c) which included benchmarks on approaches towards symmetric regulation and discussion of the context in which they were applied.

an exceptional case, going well beyond the provision of access to in-building infrastructure, which is the core focus of the provisions.[534]

7.3.2.5 Summary

The identification of a broad market at EU level covering all forms of wholesale broadband access is likely to increase divergent application at national level and may result in insufficiently granular analysis of different types of wholesale access, with differing investment requirements and implications for competition. It may also increase the risk that broadband markets are declared to be effectively competitive when competition problems may nonetheless persist. This option risks fragmentation of the single market, as well as premature deregulation (or undue focus on bitstream), and therefore has the potential to undermine the development of competition, especially in areas where infrastructure duplication is not viable. This could lead to reduced choice, poorer quality and higher prices for end-users.

The maintenance of a WLA market coupled with the removal of the WCA market from the list could focus attention on the effective implementation of physical and virtual access (and associated backhaul where required), while reducing the regulatory burden and constraints associated with the analysis of the bitstream market. Intensified focus on implementing VULA should support competition in VHC-based services. The impact on competition and consumer welfare in rural areas should be limited if measures are taken to foster the development of wireless solutions together with the availability of backhaul as appropriate.

Removal of markets for mass-market wholesale broadband access risk either premature deregulation, undermining competition and consumer welfare, or excessive reliance on symmetric regulation as an alternative, which could impose a regulatory burden across a wider group of operators.

These effects are summarised in the following table:

534 Article 61(3) of the Code provides that If justified on technical or economic grounds, national regulatory authorities may impose active or virtual access obligations. However, this provision comes after provisions stating that access may be mandated to in-building wiring or at the first concentration point, and it is implied that active access obligations beyond the first concentration point may only be imposed if access to in-building wiring or the first distribution point do not do not sufficiently address high and non-transitory economic or physical barriers to replication which underlie an existing or emerging market situation significantly limiting competitive outcomes for end-users.

Table 7-5: Impact of different options for wholesale data access regulation compared with the status quo

	VHC deployment and access		Competition		End-user welfare			Single market	Admin. cost
	Availability	Take-up	Inf	Serv	Choice	Price	Quality		
Option 1a: Broad market	+/-	+/-	-	(+)	+/-	+/-	-	--	0
Option 1b: Narrow market (WLA only)	0	0	0	(-)	(-)	0	+	+	(+)
Option 2a: Removal of WLA & WCA markets, deregulation	+	-	(+)	--	--	-	+/-	-	++
Option 2a: Symmetric regulation in place of SMP	(-)	(-)	-	+/-	+	+/-	+/-	-	--

+,-, 0: Positive, negative or no effect compared with status quo. (+) some possible effect, or effect limited in geographic scope. +/- effect depends on circumstances

Source: WIK-Consult based on benchmarks, modelling and interviews

7.4 Dedicated capacity

7.4.1 Relevant options

7.4.1.1 Option 1a: Market restricted to terminating segment

Under this option, a market for dedicated access would be included in the list of markets susceptible to ex ante regulation. This market would encompass terminating segments of leased lines (with a focus on fibre-based lines)[535] and dark fibre for any purpose (including fixed and mobile backhaul). The market for trunk segments, would as currently, not be included in the list of relevant markets, but NRAs would be free to analyse and include certain routes, with reference to the 3 criteria test, if these are found to present enduring competition challenges. It is likely, in view of our analysis in section 5.2.6.3, that the market for dedicated access would be subject to geographic segmentation.

535 It is likely that in time, copper-based leased lines will give way to fibre in most cases.

7.4.1.2 Option 1b: Both terminating and trunk segment included in list of recommended markets

Under this option, dedicated access in both terminating and trunk segments would be included in the list of markets susceptible to ex ante regulation. As above, this market would encompass leased lines (with a focus on fibre-based lines) and dark fibre for any purpose. However, regulation would extend to inter-exchange (trunk) routes not covered under option 1a. NRAs would be advised to conduct a geographic assessment of both the terminating and trunk segments – the latter on a route by route basis.

7.4.1.3 Option 2: Market not listed in the list of relevant markets susceptible to ex ante regulation, but other options remain available

Under this option, the current market 4 (high quality access) would be removed from the list of markets susceptible to ex ante regulation. However, it would remain open for NRAs to apply regulation if they conclude that the 3 criteria test is passed at a national level. It might also be possible, under certain circumstances, to apply symmetric regulation under article 61(3) of the Code in a manner which supports the availability of certain access segments for business use. Remedies under competition law, including remedies associated with state aid and merger proceedings or the abuse of dominant market position, would remain available.

7.4.2 Impact assessment

7.4.2.1 Regulatory implications

The inclusion of a market for dedicated „terminating“ segments would provide continuity with respect to the current market for „high quality access“, and is unlikely to result in significantly different practices compared with those taken by NRAs under the current Recommendation. One difference would be the focus on dedicated capacity rather than the presumption that business-grade bitstream may substitute for dedicated capacity. This may prompt those NRAs which have considered business-grade bitstream within the HQA market to consider the demand and supply conditions for this form of wholesale access (including the need for business-grade SLAs) within the WLA market. It is notable however, that relatively few NRAs have included business-grade bitstream within the HQA market (see Table 5-6). Another change to the previous recommendation is the proposal to include dark fibre in the terminating segment to be within the scope of this market. This may prompt NRAs to place greater focus on assessing the supply conditions for dark fibre, including the potential for self-supply and commercial access for different use cases (including fixed and mobile backhaul), and may result in the imposition of access obligations on dark fibre in certain areas, subject to terms and conditions that preserve incentives for self or co-deployment, wherever viable. The recommendation to conduct a geographic market analysis may result in some countries which had considered that fibre-based leased lines or higher bandwidth leased lines were competitively supplied, finding that the degree of competitive supply of such lines varies by geography and proximity to the networks of potential suppliers. This could result in regulation on the supply of such lines being introduced in certain geographic areas. NRAs would, as today, be required to conduct an assessment of the 3 criteria test at national level, if they consider it necessary to regulate certain trunk (inter-exchange) routes.

The definition of a wider market or two markets encompassing dedicated access in both the terminating and trunk segments of the network, would require NRAs to undertake an analysis of the trunk market on a routine basis. This would represent a reversal of current practice, and would likely present an additional administrative burden, given that most NRAs have concluded that the trunk segment is competitively supplied.[536] The reinclusion of this market could also result in the introduction of regulation on access to trunk segments in some cases. However, regulation of certain routes via SMP analysis of the trunk segment could also replace regulation of inter-exchange connectivity that may have been applied in some countries as an associated facility to LLU or ODF access,[537] and might in this context ensure that regulation is not applied on backhaul from all exchanges, but only those for which there is limited competitive supply.

The removal of the high quality access market from the list of markets susceptible to ex ante regulation is likely to result, in most cases in the deregulation of these products, as has already occurred in countries such as Sweden, which benefits from the widespread availability of dark fibre from municipal operators, and Bulgaria and Romania, which are characterised by fibre infrastructure duplications. However, it could also prompt some NRAs to consider whether dedicated access for business purposes could be mandated as symmetric remedy in the context of article 61(3) of the Code. Indeed, ARCEP has proposed in a February 2020 consultation, to extend its symmetric regulatory regime for access to the terminating segment of mass-market FTTH, so that it also covers some elements which are relevant to dedicated access provided to larger enterprises.[538] Removal of the market from the list of markets susceptible to ex ante regulation could also result in some regulators which had not previously taken this approach, regulating access to dark fibre and leased lines for backhaul as an associated facility to the WLA market, if that market remains in the list.

7.4.2.2 Administrative costs

10 of the NRA responding to the survey provided quantitative estimates of the time required to conduct an analysis of the high quality or dedicated access market. The median time reported was around 210 man days while the average was 400 man days. Reported time

536 See the EC's market overview table at European Commission (2019d).

537 For example an obligation to provide access to Lien de fibre optique (LFO) is mandated as an associated facility in France. This link can connect two exchanges or link an Orange exchange to the exchange of an alternative operator. See ARCEP (2015).

538 ARCEP Feb 2020 Consultation on proposed adaptations to the symmetric regime to reflect requirements for dedicated access to larger business premises https://www.arcep.fr/uploads/tx_gspublication/adm-fixe-decision-symetrique-20200206.pdf taken was split between those NRAs taking a relatively limited time to analyse this market, and those which considered the effort required was significant and close to that associated with analysing the WLA and WCA markets.

Those reporting higher resourcing on this market noted the challenges of analysing customised offers and taking into account the multi-site dimension of the retail market. Several NRAs observed that the geographic analysis that is required to analyse this market in detail was complex, and needed to be conducted at a granular level, with continuous monitoring. In cases where geographic assessments had not yet been introduced, these were considered likely to increase the resources required to effectively analyse the market.

Nearly all NRAs responding to the survey reported that the trunk segment had been deregulated, and therefore a requirement in the Relevant Market Recommendation to analyse this market would add additional effort.

Limited feedback was received on the administrative costs associated with the regulation of dedicated and trunk segments from stakeholders. The business operator responding observed that the time taken to engage in this market analysis was the same as that associated with engaging on the WLA market (which in many countries includes wholesale products which are relevant for business provision). Considering trunk segments in addition to terminating segment was considered to add some, but not significant, additional resource.

7.4.2.3 Implications for stakeholders

<u>Incumbents</u>

Incumbent operators are likely to face additional competition as a result of the proposed extension of the scope of the dedicated access market to include dark fibre The impact of increased sales of dark fibre as opposed to active leased lines may include reduced value from the transaction, as well as increased capabilities for bandwidth expansion and innovation that would be made available to their competitors, which could be used to strengthen competitive offers for business access, and improve the fixed and mobile backhaul capabilities of rival firms.

The impact of the recommendation for a geographic analysis of dedicated access, depends on what were the conclusions from any previous analysis of the HQA market. Incumbents in countries which previous applied geographic segmentation will experience no change. For those countries which previously applied nationwide access regulation on fibre-based leased lines, deregulation in some areas could be expected. Conversely, those countries which concluded that higher speed or fibre-based leased lines were competitively supplied on a national basis, might conclude that when the market is geographically segmented, there may be a need to introduce access obligations outside densely populated areas and business districts, with the result that challengers may be better equipped to take market share from the incumbent in the provision of connectivity to dispersed multi-site businesses, a service segment in which incumbents such as Telefonica have been found to maintain a relatively high market share (see discussion in section 5.1.6.2). Incumbents are unlikely to be materially affected by the inclusion of otherwise of business-grade bitstream within the dedicated access market, since supply and competition in these services (and potential requirements to offer a premium/business-grade SLA for mass-market infrastructure) are proposed to be considered in the context of the WLA market.

The impact on incumbents of a renewed focus on trunk segments depends on whether they are already subject to inter-exchange dark fibre access obligations as an associated facility in the context of the WLA market. If inter-exchange dark fibre is already regulated through those means, consideration through an SMP market analysis might result in the removal of regulation on routes deemed to be competitively supplied. If there is no pre-existing inter-exchange connectivity regulation, the requirement for NRAs to consider a trunk segment may lead to new regulatory obligations for incumbents on certain routes. The removal of market 4 (high quality access) from the list of markets considered susceptible to ex ante regulation is likely to be positive for incumbents, as it would result most likely in the widescale deregulation of terminating segments of leased lines. In addition to releasing incumbents from pricing and access obligations, this would tend to give incumbents an advantage when bidding for contracts to deliver connectivity for multi-site corporations or public services, especially when sites are dispersed around the country, as well as in constructing 5G networks.

Cable operators

As the main focus of cable operators‘ business tends to be on residential consumers and small businesses, cable operators are unlikely to be materially affected by any changes to market definition and regulations concerning dedicated access including their removal. Cable operators which seek to compete in the provision of wholesale dedicated access, may face strengthened competition arising from dark fibre regulation. Cable operators which are also present in mobile markets may benefit from provisions which grant them access to dark fibre and other backhaul infrastructure in areas beyond the reach of their network.

Regional fibre investors

Regional fibre investors or utilities which rely on providing wholesale access to support their business model (in the terminating segment or for long distance routes e.g. along railway lines), may be affected by additional competition stemming from an obligation for SMP operators to provide dark fibre in the terminating and potentially certain routes of trunk segments. This could in some cases result in those operators losing market share for leased lines or dark fibre to large business sites, or for mobile backhaul. The impact of such targeted competition is illustrated in section 7.2.2.3.

However, the presence of competition from regional fibre investors or utilities in the supply of wholesale services should be taken into account when NRAs assess market conditions for the provision of dedicated access (potentially leading to a no SMP finding in the regions covered by such operators). Moreover in the event that SMP is nonetheless found, remedies for dark fibre could be tailored to incentivise own or joint construction of backhaul e.g. using PIA. These factors should in practice reduce the impact on regional fibre investors of the inclusion of dark fibre within the scope of the relevant market, while safeguarding competition. The removal of the market for high quality access would in general be positive for regional fibre investors, as it would remove a potential source of competition to their own offers.

Access seekers

Access seekers including mobile operators without extensive fibre infrastructure and specialist business providers are likely to benefit from provisions which support the availability of access to dark fibre outside areas of competitive supply, as this should enable them to compete more effectively with the incumbent in terms of reach and quality of provision. Access seekers are also likely to benefit from guidance which advises that NRAs should conduct a geographic analysis on dedicated access markets, rather than assessing market shares only with reference to speed or technology, as this may make it more likely that access obligations are applied for fibre terminating segments of leased lines and/or dark fibre apply in areas which are not competitively served. However, a geographically segmented approach to market analysis, may also increase the need for access seekers to rely on different suppliers in different areas, which may increase the complexity of their business model.

The effect on access seekers of extending the market or adding a new market covering trunk segments of leased lines depends on the pre-existing situation. In some cases it may result in deregulation of some inter-exchange routes which were previously regulated as associated facilities to LLU or ODF access, whereas in countries where such routes were not previously regulated, it could result in regulation being applied on some less competitive routes, which could increase the potential to increase the quality of provision and/or make use of local access or deploy wireless access in such areas.

7.4.2.4 Impact on VHC connectivity, competition, end-user welfare and the single market

Inclusion of a market covering terminating segments only (including dark fibre)

The inclusion in the Relevant Market Recommendation of a market for dedicated access in the terminating segment (including dark fibre) should have a positive impact on VHC connectivity to businesses and public institutions if it includes a provision to deploy such lines on demand (as is typical for the provisioning of this infrastructure).[539] There should be no

539 In several countries, including FR, DE, IE, NL and UK, a distinction is made between wholesale “on-net” leased lines and lines requiring some degree of “excess construction”. In some cases, a limited degree of excess construction for the connection of the line is included within the “standard” offer/price. Additional construction costs above a given level or beyond a given distance are generally associated with a higher connection fee. See WIK (2014, table 1).

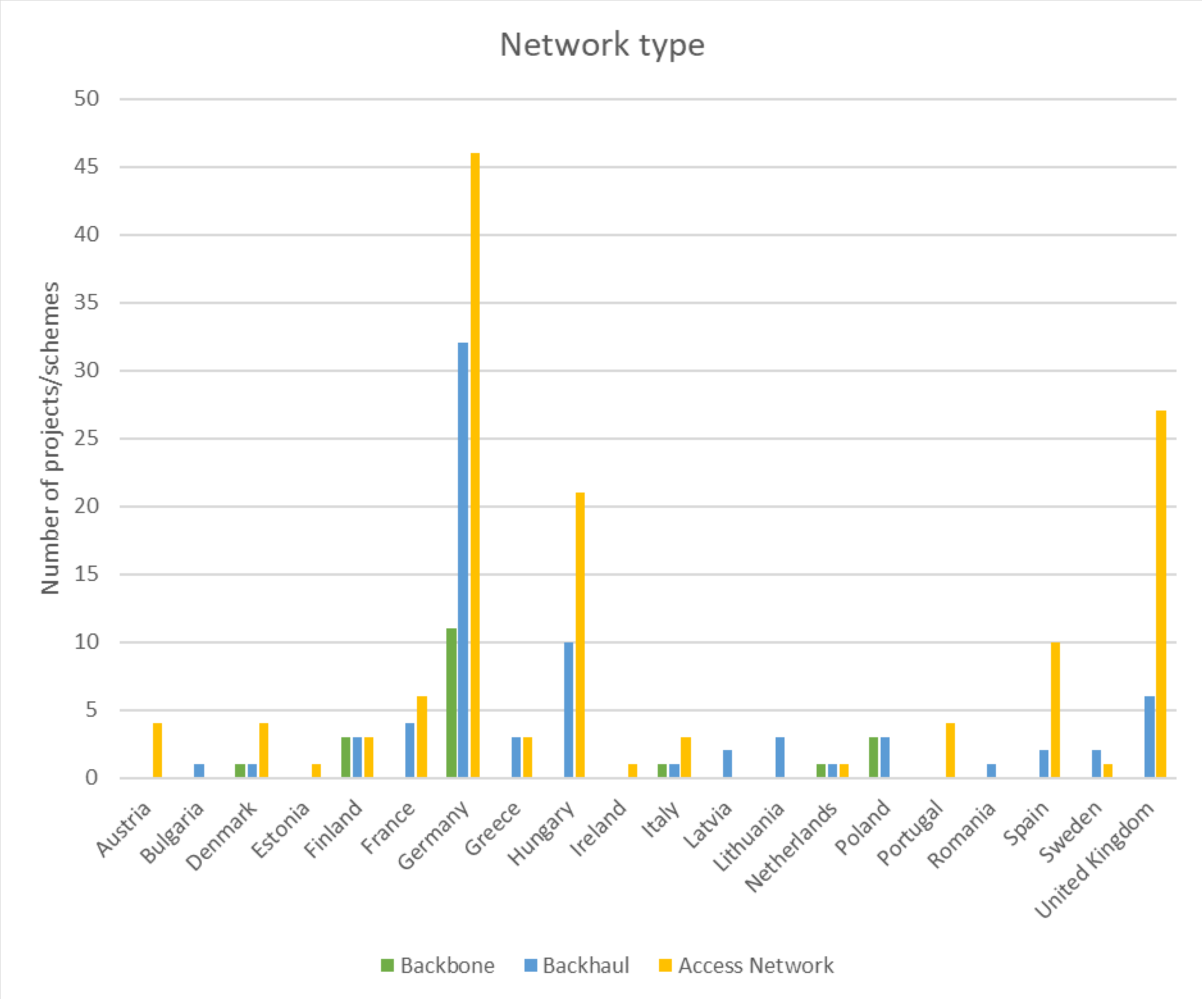
chilling effect on the deployment of or infrastructure competition in fibre lines for business use, providing a proper geographic analysis is conducted, which excludes zones which could be competitively supplied. By ensuring access to dedicated fibre lines for any use in areas of limited competitive supply or self-supply, inclusion of this market should also support competition in a variety of downstream markets, including the provision of services to larger businesses (including multi-site businesses), and the provision of fixed and mobile/wireless broadband, including 5G.

The potential for FTTH ownership to confer an advantage when it comes to deployment of 5G is illustrated in a cost model prepared by Comsof, which illustrates the cost-savings made possible by deploying FTTH in a manner which is 5G ready. The study concludes that if a 5G network was anticipated while planning for a FTTH network, cost savings due to convergence could reach between 65-96%.[540] In those countries where FTTH beyond dense urban areas has been deployed primarily by the incumbent, a lack of access to dark fibre for 5G mobile backhaul could present a significant disadvantage to competitors attempting to compete on a nationwide basis. Equally, while wholesaling opportunities may be greater, there may be a need to assess dark fibre access terms in cases where such access is available only from a single non-incumbent provider.

More evidence of the existence of bottlenecks in competition for fibre backhaul (due to the lack of viability of replication) comes from the fact that backhaul has been the subject of state aid support in a number of countries (see below), with the key aim of improving the business case to deploy fixed and wireless access in more remote areas. Targeting of EU funding at dark fibre connections for socio-economic drivers and 5G backhaul in remote areas was also considered necessary in the context of a 2019 study by Ecorys, WIK et al on Implementation of CEF2 Digital.[541] Alongside backhaul links which are considered not to be commercially viable (and therefore warrant state aid), it can be presumed that there may be a potentially greater number of links which are commercially viable, but cannot be viably duplicated. Moreover, access obligations on connections funded via state aid may be subject to a time limit.

540 FTTH Council Europe (2019b).
541 Ecorys et al. (2020).

Figure 7-9: Number of state aid projects by network segment, former EU28



Source: VVA on the basis of member state questionnaires (latest update: February 2020)

Regulated access to dark fibre (and leased line) terminating segments for backhaul would ensure that access is available to such connections for as long as one or more players have SMP in such connections. In turn, such access (or commercial agreements which are facilitated by the potential for access) should support continued competition in downstream fixed, mobile and wireless provision. Availability of dark fibre backhaul is likely to play an increasingly important role in facilitating competition in 5G service provision as the number of base stations requiring fibre connectivity increases. Access to backhaul will also be necessary to facilitate competition in wireless VHC broadband in rural areas, which could over time replace copper connections in areas where FTTH to every home is not viable.

End-users across these market segments should in turn benefit from greater choice, increased quality (in terms of bandwidth), and potentially lower prices, in cases where the provision of access avoids the need for more inefficient or costly solutions to bring bandwidth to those areas.

Inclusion of a market covering terminating and trunk segments (including dark fibre)

If trunk segments (including dark fibre) are also covered by the list of relevant markets susceptible to ex ante regulation, the impact on competition, investment and end-user welfare may depend on the pre-existing situation. If trunk segments had been fully deregulated, but there are some routes which are not competitively supplied, a recommendation to analyse and where necessary regulate this segment could improve the prospects for deployment of as well as quality and choice in wireless networks as well as potentially supported increased competition via available local access. However, if as is anticipated, the existence of such cases is limited,[542] inclusion of the trunk segment in the list of relevant markets could increase administrative costs (for all those countries where specific analysis is not needed) without affecting the regulation applied in practice. Thus, there would be no or limited effects on deployment, competition and end-user welfare overall, which would likely be outweighed by the administrative burden. In a worst case scenario, inclusion of the trunk segment which leads to over-regulation of this market, could limit incentives for operators to self-deploy trunk lines.

Removal of the high quality access market from the list

The removal of the high quality access market from the list of markets potentially susceptible to ex ante regulation is likely to limit the deployment of and competition in VHC networks to businesses and public services in areas outside dense urban districts in which such lines cannot be viably duplicated, as it would not be possible for challengers to order the provision of lines for such customers and/or compete effectively with the incumbent in the provision of services which cover these sites. Moreover, the absence of such a market would limit the potential to ensure the availability of wholesale access to leased lines or dark fibre required to support the provision of mobile and wireless networks in more remote areas, potentially undermining the availability of and competition in 5G mobile and FWA. Business end-users and those in more rural areas relying on mobile or wireless connections would likely experience lower quality, less choice and higher prices as a result. Replacement of SMP regulation in this market with symmetric regulation could risk overly intrusive regulation, as such rules would apply to all operators deploying fibre rather than those found to have market power. Meanwhile, increased reliance on „associated facilities“ to mandate backhaul could reduce flexibility over the use case and location of backhaul, and may not be subject to the same analytical rigour or market segmentation, risking over-regulation.

7.4.2.5 Summary

Including a market for dedicated capacity (including dark fibre) in the list of relevant markets, with a recommendation to conduct a geographically segmented analysis and distinguish

542 This is suggested by the relatively few markets in which trunk segments continue to be regulated to date e.g. connections to certain Islands in Spain, routes in the UK, although the true figure could be obscured by the use of associated facility regulation for this purpose.

legacy/copper-based lines from fibre should boost deployment in the supply of VHC services to larger business sites and public institutions situated outside dense areas, as well as enabling competition in the supply of services to these sites (and for multi-site contracts). Ensuring availability of dark fibre and leased line access in areas which cannot be viably served with multiple infrastructures should also support competition in the provision of fixed broadband in rural areas (in conjunction with WLA), as well as deployment of mobile and wireless services in these areas. End-users across a variety of market segments should benefit from this approach.

Extending the market to include trunk lines could further support competitive supply to the most rural and remote communities. However, analysis across the EU suggests that these cases are limited, and therefore an EU wide recommendation that this market is susceptible to ex ante regulation may result in excess administrative burden to limited effect. Such analyses should more appropriately be conducted and the 3 criteria test conducted at national level.

Removing the HQA market is likely to limit competitive supply to businesses, public institutions and mobile antennas beyond densely populated areas, and would thus have a detrimental effect on quality, choice, and potentially the price of services available in these areas. The inclusion of a market for dedicated connectivity would mostly compensate for the removal of such a market, leaving any remaining issues associated with the competitive supply of business-grade bitstream to be addressed through the WLA market.

Table 7-6: Impact of different options for wholesale dedicated access regulation (incl dark fibre for all use cases, geographic segmentation) compared with the status quo

	VHC deployment and access		**Competition**		**End-user welfare**			**Single market**	**Admin. cost**
	Availability	Take-up	Inf	Serv	Choice	Price	Quality		
Option 1a: Terminating segment only	+	+	+	+	+	+	+	+	-
Option 1b: Terminating and trunk	+/-	+	+/-	+	+	+	+	0	--
Option 2: Removal of HQA market	-	-	-	-	-	-	-	-	++

+,-, 0: Positive, negative or no effect compared with status quo. (+) some possible effect, or effect limited in geographic scope. +/- effect depends on circumstances

Source: WIK-Consult based on benchmarks, modelling and interviews

7.5 Termination

7.5.1 Relevant options

7.5.1.1 Option 1: (status quo) retain Termination markets in the list of relevant markets susceptible to ex ante regulation.

Under this option, NRAs would be legally obliged to continue reviewing the two termination markets under their jurisdiction.

Option 2a: Termination Markets not listed in the list of relevant markets susceptible to ex ante regulation

Under this option, it is envisaged that all regulation currently applying to fixed and mobile termination would be lifted. NRAs seeking to maintain current obligations – including the publication of reference interconnection offers and non-discrimination obligations – would be required to demonstrate that the three criteria test is fulfilled in their jurisdiction.

Option 2b: Termination Markets not listed in the list of relevant markets susceptible to ex ante regulation accompanied by Commission guidance to manage the transition to symmetric remedies

This option corresponds to option 2a with one significant difference: the transition from the current SMP remedies to equivalent symmetric remedies would be supported by EU guidance and a mechanism would be set in place to ensure that more experienced NRAs effectively share their experience with less experienced or staffed NRAs.

7.5.2 Impact assessment

7.5.2.1 Regulatory implications

If the two termination markets are left in the list, it is likely that NRAs will continue to reach the conclusion that all operators with which direct interconnection is sought, have SMP because of their ability to discriminate when providing interconnection or delay the provision of requested interconnection services. Markets will further be defined very narrowly given that only the operator of each network can provide interconnection and that there are no substitutes. Under this option, it is thus likely that NRAs will rely on the Eurorate as regards price regulation, but may continue to impose other remedies on at least all MNOs and the main fixed operators. It is possible, although this scenario was not raised by the NRAs interviewed for this impact assessment, that NRA may find that, notwithstanding the Eurorate, there may still be an ability for operators to unduly discriminate (below that rate).

MVNOs and smaller operators may be seen as price-takers without bargaining power and not subject to detailed regulation.

If the markets are removed without any expectation that other measures may be used, NRAs would most likely cease analysing markets and applying remedies on termination in most cases. Decisions concluding that the three criteria test are fulfilled, would likely be challenged by the operators concerned. NRAs would then need to convince the appeal court concerned that the national market conditions differ from those which were assumed by the Commission when it adopted its Market Recommendation and that despite the symmetric remedies foreseen in the EECC and implemented in national law, the (narrowly defined) markets do not tend to competition from a forward-looking perspective. If they are successful in defending the proposed findings of SMP, the NRAs would need to adapt the current remedies to the new context – removing pricing obligations – and refocussing remedies on other aspects. Under this option, it would be more difficult for NRAs to designate MVNOs and smaller fixed operators as having SMP than under option 1, because NRAs would face the full burden of proof that markets (in this case on individual operators) are not tending towards competition (criterion 2).

Under option 2b, most NRAs would likely not feel the need to show that the termination markets pass the three criteria test. Instead, these NRAs would divert their resources towards setting out symmetric remedies and building up capacity to deal with dispute resolution. Moreover, whereas in option 2a, operators (and therefore NRAs) might dedicate substantial resources towards litigation, this is less likely in option 2b where BEREC or Commission guidance and best practices could be invoked in court, and would thus reduce the chances of successfully challenging the symmetric measures.

7.5.2.2 Implications for stakeholders

The implications will vary depending on the category of stakeholders.

Incumbent fixed operators and MNOs may see their regulatory burden remain the same or potentially increase under Option 1, if NRAs use successive market reviews to examine additional issues related to interconnection. Under scenario 2a (lifting of all regulation apart from the Eurorate), the regulatory burden is likely to decline for incumbent fixed operators and MNOs. There may also be less scrutiny on potential access and discrimination issues associated with current interconnection and potentially interconnection associated with evolving services such as RCS, which could enable them to maintain an advantage over smaller operators and MVNOs, in cases where there are material challenges. Option 2b is likely to result in an intermediate outcome for these operators as some rules (such as the obligation to publish a detailed RIO) may be maintained under symmetric regulation, but these may not be as extensive as those applied under SMP regulation, or may not be applied in some countries. That said, enforcement could be more burdensome, due to the reliance on dispute resolution mechanisms.

For MVNOs and smaller market operators, the implications would be different. Option 1 gives them the most legal certainty. Not only would Option 1 reassure them that current obligations will be maintained, but they could expect that at each market review they can raise issues around new features or services according to technical and market evolutions. Option 2a would create the most uncertainty for them. Several NRAs may continue review the markets and find SMP, but, as mentioned, such findings are likely to be subject to appeal. Option 2b will be seen as less attractive than option 1 for this category of operators, but it would have the advantage of providing some continuity.

7.5.2.3 Administrative costs

13 of NRAs responding to a survey gave an approximation of the mandays associated with conducting reviews of termination markets under the relevant market recommendations. The associated time varied and is likely dependent on whether the time taken to calculate cost-oriented wholesale tariffs (an activity that will be made redundant by the Eurorate) is reflected or not. The median reported time was approximately 200 man days, while the average was 300 man days. Most of the responses included consideration of termination rates. Reviews are currently mostly conducted every 3 years in line with guidance under the previous regulatory framework.

NRAs generally observed that, irrespective of the decision to include or exclude termination markets from the list of relevant markets, the work associated with reviewing termination markets is likely to reduce significantly due to the implementation of the Eurorate, which should obviate the need to calculate cost-oriented wholesale tariffs at a national level.

As regards termination issues apart from price regulation, some NRAs stated that, if the termination markets were removed from the list, they would undertake the same or similar activities regarding data gathering and monitoring of the market, and enforcement of non-price obligations, either via SMP obligations (entailing application of the three criteria test) or via symmetric obligations concerning interconnection and dispute resolution. Thus, these NRAs consider that the reduction in the administrative burden of removing termination markets from the list of relevant markets would be limited. Some also highlighted that if they needed to rely on symmetric regulation and dispute resolution, it could increase the workload, due to the large number of operators present. Indeed, our assessment is that at least initially, workload under option 2b could increase for most NRAs as NRA staff go through a learning curve on applying general authorisation conditions to require network operators to apply fair and reasonable interconnection conditions, and resolving disputes raised by smaller players. Such effects could however be mitigated clear guidance and best practices provided by BEREC or the Commission.

Equally, a number of the NRAs responding to our survey, did not consider that there were substantial challenges associated with interconnection in their markets (other than price). These NRAs estimated that the effort required could be reduced if the market was no longer required to be analysed.

Operators generally agreed that moving to a Eurorate would reduce the administrative burden. An incumbent interviewed for this exercise noted that, whereas they currently had a team of 4 handling interconnect questions including bottom-up cost modelling, this could be reduced to 1 once the Eurorate comes into force, and in the event that the markets were removed from the list. Operators responding to this question observed that addressing issues associated with termination via symmetric regulation would require the same or higher resourcing compared with addressing such issues via SMP regulation. Relying on competition law to address challenges was also considered to incur additional expense.

7.5.2.4 Impact on VHC connectivity, competition, end-user welfare and the single market

The approach taken towards non-price aspects of termination under options 1, 2a or 2b are unlikely to materially influence deployment or competition in VHC networks, unless they affect the ability of alternative operators to offer fixed and mobile voice services comparable to those of the incumbent, in countries where it is common to bundle broadband services with fixed and/or mobile telephony.

However, removing the markets from the list could send a „deregulatory“ signal to financial investors, which may provide an indirect benefit to VHC investment, by suggesting that the EU is prepared to take a less interventionist stance on regulation. At the same time, deregulatory signals could reduce investor confidence in and support for business models of smaller fixed and mobile operators that may rely more heavily on access regulation.

The degree to which the different regulatory options affect competition fixed and mobile voice services depends on the extent to which there are non-price issues which affect competition amongst the players. If significant issues persist, competition – particularly from smaller players and MVNOs – might be hampered under option 2a. However, it is possible that such problems could be mitigated under option 2b (symmetric regulation), or if localised to specific countries, could be addressed via SMP regulation (after meeting the 3 criteria test).

Options 1 and 2b are most likely to provide support for the single market, including ensuring clear rules for operators seeking interconnection in multiple countries. There is a risk that with the removal of SMP regulation and absence of any EU-wide guidelines, 2a could result in fragmented and diverse approaches.

7.5.2.5 Summary

The introduction of the Eurorate is likely to reduce the burden associated with ex ante regulation of termination under all scenarios. The removal of the termination markets from the list of markets susceptible to ex ante regulation would remove additional administrative and regulatory burdens, but might, if not compensated through the introduction of some common rules via symmetric regulation, result in a greater risk of exclusionary or discriminatory conduct by incumbents and/or larger MNOs. The removal of the markets from the list coupled by complementary guidelines at EU level (by BEREC or the EC) on the appropriate application of symmetric regulatory principles to interconnection markets, could ensure that any remaining problems can be addressed where these are relevant, while reducing the regulatory burden overall (taking into account countries where non-price discriminatory or exclusionary behaviour is not considered a significant issue).

Table 7-7: Impact of different options for fixed and mobile termination markets

	VHC deployment and access		Competition		End-user welfare			Single market	Admin. costs
	Availability	Take-up	Inf	Serv	Choice	Price	Quality		
Option 1: maintain markets	0	0	0	0	0	0	N/A	0	0
Option 2a: remove markets	0	0	0	(-)	(-)	(-)	N/A	-	++
Option 2b: remove markets + EU guidance	0	0	0	0	0	0	N/A	0	+

+,-, 0: Positive, negative or no effect compared with status quo. (+) some possible effect, or effect limited in geographic scope. +/- effect depends on circumstances

Source: WIK-Consult based on benchmarks, modelling and interviews

7.6 Overall conclusions

Drawing together our analysis of the impact of the potential options for each of the markets that could be included within the list of relevant markets, we conclude that on the basis of the potential impact on VHC connectivity, competition, consumer welfare and the single market:

- In countries where SMP PIA is the primarily means by which infrastructure competition and/or new entry has developed or can be expected to develop, there is a case to define a separate market for PIA. In countries where SMP PIA is not expected to be the primary means to support infrastructure competition or entry, it may be more appropriate to rely on PIA as a remedy or potential substitute for local access in the context of the WLA market. This solution may also be cost-effective for a transitional period in countries in which SMP PIA is expected to become the primary means to support infrastructure competition, but where it has not yet been widely utilised. A separate PIA market is likely to be relevant for only a few countries today, and thus it may not yet be appropriate to include this market in the list of markets in the Recommendation that are considered to be susceptible to ex ante regulation across the EU.

- There is a case to maintain the market for WLA (and remove the market for WCA), as this could strengthen the focus on implementing VULA or physical unbundling at an economically viable connection point and in a manner which offers the maximum degree of flexibility for the access seeker. Competition in VHC broadband in more remote areas could be supported through regulation of the appropriate backhaul connections (where necessary), enabling use of local access solutions, alongside support for the development of wireless access solutions in these locations.

- There is a case to maintain, but adjust the currently defined market for high quality access (terminating segments only) so that it (a) focuses on dedicated/guaranteed bandwidth for any purpose; (b) includes dark fibre access; and (c) is subject to geographic segmentation.

- There is a case to remove the current markets for fixed and mobile termination.

Although the removal of the markets for fixed and mobile termination, alongside the WCA market may give rise to some administrative cost savings for both NRAs and operators, these savings are expected to be limited due to the fact that price controls for termination will be removed under all scenarios due to the Eurorate, and because any (likely limited) savings from forgoing the WCA analysis, in countries where this market is relevant, might be counteracted through an increased focus on operationalising VULA. Moreover, any administrative cost savings from the removal of markets are likely to be counteracted by the additional resources required to conduct detailed geographic analyses of the WLA and dedicated access markets, and potential reliance on symmetric regulation e.g. in the context of interconnection.

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